JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 15 OCTOBER, 1922 No. 5

ANT CONTROL ON SHIP BOARD

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Early in December, 1921, the Pacific Mail Steamship Company asked for help in the control of ants infesting certain of their passenger ships. This Company runs a line of vessels to and through the Panama Canal and thence northward to Havana, Cuba, and to Atlantic seaboard points in the United States. The ants were said to be very troublesome on the ships of this line. They not only caused a considerable pecuniary loss in the destruction of food stuffs but attacked passengers and crew. Their bite was reported to be very painful, causing a local swelling and inflammation with much itching. The situation as reported was worthy of careful study to develop control measures and the writer took up the study.

A careful search of the literature on ants failed to disclose any report of these creatures having been made on ship board and the problem developed, for this reason, into an entirely new study aided, to be sure, by the successful control measures used on shore. It was finally decided that to do the problem some degree of justice the study should extend through an entire voyage of one of the Company's ships. The ship chosen was the Colombia due to sail from San Francisco December 12, 1921, on its twenty-second voyage, outward destination being Baltimore, Maryland. Before the ship sailed a careful inspection was made and no ants found. As the weather was quite cold at the time, the presumption was made that the ants were dormant. Officers and members of the crew who had been on the Colombia on the previous voyage were unanimous in stating that the ants had been present in overwhelming

numbers and had caused much discomfort to all hands. Careful questioning failed to bring out any clear description of the ant so no definite fact was available on which to base a theory of control. In view of the conditions present it was thought best to provide poisons to meet various situations as they might arise. Beside a number of non-proprietary insecticides a quite complete stock of proprietary ant poisons was obtained and rather fully equipped for a thirty day campaign we left San Francisco on December 12, 1921, as scheduled. Cool weather conditions prevailed until December 14, 1921, when under the warmer conditions experienced at San Pedro, California, ants began to appear. These ants were small, not more than three millimeters in length, and were very active. They were later identified by Dr. W. M. Wheeler, Harvard University, Bussey Institution for Research in Applied Biology, as follows: "The ants....are specimens of *Monomorium* (*Parholcomyrmex*) *destructor* Jordan. The species is originally Indian and has long been known as an unpleasant house ant and is even suspected of carrying the plague. During more recent years it has become tropicopolitan.....It is interesting to find it on a ship, and of course one would expect it to become active while the ship was in the tropics."[1]

From San Pedro southward to the port of Manzanillo, Mexico, well within the tropic of Cancer, the ants increased in numbers and were exceedingly troublesome in the passengers' rooms and in the steward's crew quarters in the waist of the ship alongside the engine where the heat was greatest. They were also very troublesome in the pantries, galleys and store rooms. Experiments with various poisons and contact insecticides were begun as soon as the ants began to appear at San Pedro. Capsules containing arsenical poisons made up as per formulas A and B, (last page) were placed, opened, wherever ants were seen. Sponges moistened with the same poisonous syrups and contained in perforated tins were also freely used. These capsules and tins were inspected daily and it was found that only occasional ants visited them. Indeed it may be stated that the arsenical poisons, as used, proved to be only a partial control and not quick enough to afford the necessary relief to passengers and crew. Complaints were made and no doubt the reports as to the viciousness of their attack on human beings were correct. They would find their way in small or large numbers into the beds and their bites were very painful. Proprietary ant poisons were used dusted into the

[1]The determination was secured through the courtesy and help of the Division of Entomology and Parasitology, University of California.

beds and were found to be fairly effective in destroying ants in these situations. All of these proprietary materials had a tendency to take up atmospheric moisture and to become lumpy. As the voyage continued further southward in the tropics atmospheric humidity became greater and distribution of these remedies because of the lumpiness became more difficult. As these control agents were placed in the beds the odors coming from some of them were objectionable. Also in some cases the control was almost as bad as the ant bites inasmuch as the powder was very irritating to the skin and mucous membranes of humans. It was soon evident that a powder should be developed that was non-absorbent of moisture, practically odorless and, further, non-irritating. After considerable experimenting such a powder was developed, its component parts being sodium flouride, pyrethrum (ground stems and flowers) and starch. Formula C, last page, gives the make up of this powder in detail. It was found to be a very efficient insecticide and numerous observations showed that death of the ants followed in from twenty to thirty seconds after the material had touched them. In addition to its killing power the powder met the non-moisture absorbing, non-odorous and non-irritating conditions before mentioned. By the time the ship arrived at Manzanillo, Mexico, December 19,1921, the overwhelming strength of the infestation was shown and the efficacy of the formula C powder demonstrated. The powder was dusted freely in passengers' rooms, steward crew's quarters, pantries, on grated floors of galleys and in the store rooms. The ants were well in control through this treatment by the time the ship arrived at San José de Guatemala, December 23d. From this point on, though tropical weather conditions with much humidity prevailed, through the Canal and to Havana, Cuba, but few ants were seen and no complaints from either passengers or crew were registered. The few ants that did appear in the pantries and syrup lockers were quickly disposed of with the formula C powder. From Havana northward past Cape Hatteras to Norfolk, Virginia and Baltimore, Maryland, cool to blizzard weather was experienced. The ants disappeared entirely, going into dormancy because of the cold and very careful search failed to disclose their nesting places.

It is interesting to note that but one formicary was found on the outward trip. This was a small one comprising but a few hundred individuals and was located in a fairly large pot of earth in which was growing an ornamental plant. This was in the dining saloon and its removal and destruction resulted in nearly complete relief from the pest in that part of the ship.

The Colombia remained at Baltimore four days and began the return trip on January 12, 1922, and left Norfolk, Virginia, on the 14th. Arsenical syrups, formulas A and B, were placed in all rooms on that day though no ants were seen. Indeed they did not appear till we left Havana, Cuba and were in the Caribbean Sea January 18th. The attack was light and easily controlled with the formula C powder. On the night of January 20th a vicious attack by the ants were reported in three rooms directly across from the engine room. These rooms were visited at midnight and it was found that the ants were attempting to establish formicarys in the beds. They were carrying pupae to these beds in great quantity. A liberal use of the powder quickly relieved the situation. The following day the cause of the migration was discovered. A boy had been sent up the ventilator shaft connecting with the engine room. The boy's visit was for purposes other than ant hunting but he got into a well populated formicary in the shaft. He came out in a hurry, literally covered with ants. He was severely bitten. This disturbance had undoubtedly made the ants uneasy, hence the attempt to establish new formicarys. Owing to the necessity of keeping these ventilators in active use while the engines were going, drastic treatment of them had to be put off till January 23d while the ship was lying at the dock at Cristobal, Canal Zone. Here we had the outside ends of the ventilators covered with canvas and then ran live steam into them for an hour. Vast numbers of ants were destroyed by this action. From January 24th on, only occasional small straggling groups of ants were seen and no complaints were registered. The last ants were seen as we left Manzanillo, Mexico, northbound on February 3, 1922. We here experienced cold weather conditions which continued until our arrival in San Francisco on February 10th. Careful inspection and search failed to disclose a single ant. They undoubtedly had again gone into dormancy and so ended the ship board ant campaign.

The frequently recurring dormant periods seem to stimulate these ants to very active work when warm conditions supervene. In the period that this study was made, fifty-eight days, the ants were dormant three times and the time devoted to reproduction and the gathering of stores was brief as compared with the same activities under normal conditions on shore. Certain it is that these ants were numerous, active and vicious.

In view of the seriousness of the pest on shipboard, the money loss due to their depredations on stores and the extreme discomfort their

presence gave passengers we recommended, first: A complete fumigation of the affected ships with sodium cyanide gas. Second: The equipment of the Chief Steward's office with a full supply of perforated tins, with sponges, and a quantity of the formula A and B syrup. Third: That formula C powder be furnished the same office in quantity. These last two recommendations were made so that the steward and his helpers might be in a position to combat ants did they appear in spite of the fumigation. These recommendations have been acted upon and the economic control of this pest on shipboard has been accomplished.

FORMULA A, GOVERNMENT FORMULA FOR ARGENTINE ANT POISON:

Granulated sugar	9 lbs.
Water	9 pts.
Tartaric acid (crystalized)	6 grams
Benzoate of soda	8.4 grams
Boil slowly for 30 minutes. Allow to cool.	
Dissolve sodium arsenite (C.P.)	15 grams
In hot water	½ pt.
Cool. Add poison solution to syrup and stir well. Add to the poisoned syrup:	
Honey	1¼ lbs.
Mix thoroughly.	

FORMULA B, FORMULA FOR NATIVE ANT POISON:

White Arsenic	2 oz.
Caustic soda	2 oz.
Sugar	1 lb.
Water	1 pt.

FORMULA C

6 parts by bulk—Sodium flouride
2 " " "—Pyrethrum (Buhach) powdered stems and flowers
2 " " "—Corn starch

Teaspoon, tablespoon, cup, indeed any convenient measure may be used in making up this powder. Care should be taken to maintain the above given porportions. This powder can be easily used in beds and where ants are by dusting from can with perforated top.

THE ATTRACTION OF *CHLORIDEA OBSOLETA* FABR. TO THE CORN PLANT[1]

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A complete study of the life economy of any insect must eventually include a consideration of the fundamental activities necessary for the

[1]Contribution No. 65 from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 9 of the Agricultural Experiment Station. The writer desires to express his appreciation for the assistance rendered by Mr. H Yuasa in the experimental work of 1919, and in securing certain literature not available in the Station Library.

perpetuation of the species. It is a recognized fact, as has been pointed out by Hewitt[2], Brues[3], and others that in most cases the female insect selects the larval food by depositing its eggs on substances best suited for the nourishment of the larvae and that this instinctive behavior or response to chemical stimuli has untold possibilities in the solution of many entomological problems. Brues attributes the selection of food plants to one or several factors, namely, (1) the odor and taste of the plant, (2) some attribute of the plant, perhaps an odor, but far less pronounced to our senses, (3) a similarity of the immediate environment or general form of the plant, and (4) apparent chance associations that have become fixed whereby diverse plants are utilized by oligophagus species.

In the study of the corn earworm (*Chloridea obsoleta* Fabr.) which has been in progress at this Station for several years, considerable attention has been given to oviposition, since the plants and parts of plants selected for egg deposition determine largely the feeding habits of the larvae. The corn earworm presents many difficulties in a study of its field activities because of its cosmopolitan distribution and wide range of food plants. It is generally conceded, however, that throughout its habitat it manifests a decided preference for the corn plant wherever present.

A review of the literature indicates that comparatively little study has been made of oviposition, and many workers leave the impression that the eggs are deposited indiscriminately on the plant. Quaintance and Brues[4], however, state that in the case of corn, the silks are usually chosen first if these are present on the plants. Egg counts which they made on silking plants indicate that approximately 40 percent of the eggs are deposited on the silks. These writers followed the oviposition on cotton and found a more promiscuous distribution of the eggs. A Total of 1141 eggs were found on cotton, 28.5 percent of which were deposited on the squares, and they state that it is quite possible that the large number of eggs laid on the squares is accidental and due to the attraction offered by them on account of the nectaries on which the moths feed. At any rate, the moths appear to oviposit indiscriminately wherever they happen to alight on the plant.

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[2]Hewitt, C. G., Insect Behavior as a factor in Applied Entomology. In Journ. Econ. Ent. 10:81-91, 1917.

[3]Brues, C T., The Selection of Food-Plants by Insects with Special Reference to Lepidopterous Larvae. In Amer. Nat. 54:313-332, 1920.

[4]Quaintance, A. L., and Brues, C. T., The Cotton Boll-worm. U. S. Dept. Agri., Bu. Ent. Bul. 50, 155 p., 1905.

In a previous paper, the writer[5] called attention to the fact that the moths show a decided preference for the silks of corn and, that when these are not available, the upper surface of the leaves and the stalk are selected. During the period 1913-1918, a total of 6867 eggs were found on 128 plants under daily observation from germination to maturity. Of these, 2100 or 30.6 percent were deposited on the silks. In order to discover whether the moths showed a preference for the plants while in silk, observations were begun in 1914 to determine the number of eggs deposited on the plants while in silk in comparison with the total number of eggs found. These data are presented in Table I, while Table II shows the location of the eggs deposited during the silking period.

TABLE I.—SHOWING THE NUMBER OF EGGS DEPOSITED WHILE THE PLANTS WERE IN SILK IN COMPARISON WITH THE TOTAL NUMBER OF EGGS—1914-1918.

Year	Total No. eggs	No. deposited while plants were in silk	% deposited while plants were in silk
1914	4646	2963	63.7
1915	330	260	78.7
1916	129	35	27.1
1917	92	84	91.3
1918	1091	459	42.1
	6288	3801	60.4

TABLE II—LOCATION OF EGGS DEPOSITED ON PLANTS WHILE IN SILK—1914-1918.

Year	No. of plants	Leaf Upper	Surface Lower	Silk	Husk	Tassel	Stalk	Total	% of eggs on silks
1914	24	663	208	1546	89	164	293	2963	52.1
1915	24	46	3	161	5	7	38	260	61.9
1916	20	10	2	11	0	3	9	35	31.4
1917	20	8	1	56	5	0	4	84	66.6
1918	25	109	37	211	23	20	59	459	46.0
Total	113	836	251	1985	122	194	403	3801	52.2

From the data presented in the tables, it seemed apparent that the silks offered some attraction for the moths, since over 60 percent of the eggs were deposited during the period that the plants were in silk and 52 percent of these eggs were placed on the silks. In connection with these tables it is well to mention that 1916 and 1918 were very poor corn years, due to drought and hot winds. As a result, many of the plants did not produce silks and when they did appear they were soon destroyed by the extreme climatic conditions. It is also worthy of notice that under favorable conditions the silks are available for a short period in comparison with the other parts of the plant.

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[5]McColloch, J. W., A Study of the Oviposition of the Corn Earworm with Relation to Certain Phases of the Life Economy and Measures of Control. In Journ. Econ. Ent., 13:242-255, 1920.

Observations on the behavior of the moths while ovipositing also indicate that they manifest at least a slight preference for the silks. More time is usually spent on the silks and it is not uncommon for the moth to deposit several eggs before leaving. The time spent on the other parts of the plant is usually very brief, and seldom more than one egg is deposited in a place. It might also be mentioned that the adults do not make use of the silks as a source of food, except possibly when the latter are saturated with moisture.

A study of these data suggested the possibility of a chemotropic response of the adult through the olfactory senses since the silk does possess a distinct odor. During the past three years certain preliminary experiments have been undertaken on the odor of corn silk as an attraction for the earworm moths. Imitation silks were made by taking 30 or 50 strands of cotton twine or yarn about 9-10 cm. in length and tying them together at one end. These were then impregnated with the odor of corn silk by soaking in juices obtained by crushing fresh silks every evening. In the following discussion these are spoken of as treated silks. Other sets were prepared identical with the above, except that they were not soaked in the juices and these are designated as checks. During 1919 and 1920 these imitation silks were placed in pairs on opposite sides of corn plants which bore no ears and were attached to the plants about 90 cm. above the ground. In 1921 they were placed on stakes set about in the corn field in order to eliminate any attractive effect which the corn plants might have on the results. Seventeen pairs of imitation silks were used during the three years and the results are presented in Table III.

TABLE III.—SHOWING THE NUMBER OF EGGS DEPOSITED ON THE IMITATION SILKS, 1919-1921.

Experiment No.	Period	No. of eggs Treated	Check	% on treated
1	Aug. 11—Sept. 9, 1919	20	3	86.9
2	" "	17	6	73.9
3	" "	11	4	73.3
4	" "	21	0	100.0
5*	" "	12	2	85.7
6	Aug. 27—Sept. 29, 1920	20	3	87.0
7	" "	15	4	79.0
8	Sept. 1 "	17	5	77.3
9*	" "	17	8	68.0
10	" "	32	2	94.1
11	" "	36	10	78.2
12	Sept. 4 "	42	26	61.7
13	" "	39	12	76.4
14*	Aug. 8—Sept. 19, 1921	24	4	85.7
15*	" "	22	4	84.6
16*	" 15 "	13	2	86.6
17*	" "	9	2	81.8
		367	97	79.1

*Placed on stakes removed from corn plants.

These experiments indicate that odor may be an important factor in attracting the moths to the corn plant, and that the subject is worthy of further investigation. A total of 464 eggs was deposited on the twines during the three years, and 79.1 percent were placed on the treated ones. The same results were obtained regardless of whether these twines were placed on corn plants or on stakes removed from the plants. Moths were observed on these "silks" at various times and when on treated ones they behaved very much as when on corn silks, often spending some time there and depositing several eggs. On the other hand, when they were on the check twines they appeared restless and often left without ovipositing. The treated twines retained the corn silk odor for several days.

The problem now resolves itself into a study of the composition of corn silk since the final interpretation of the results and the continuance of the experiment are dependent on this knowledge. A survey of the literature gives but little help on this point, since the constituents are but indefinitely known, although corn silk has long been recognized officially in the United States as a drug under the names "Zea," "Maidis stigmata" or "Corn silk." Insofar as the writer has been able to learn, practically all of the analytical work on the composition of corn silk has considered it as a drug.

Rademaker and Fischer[6] made an approximate analysis of the drug, corn silk, and a summary of the constituents which they found is given, together with the methods used in making the determination. (Table IV.)

TABLE IV.—SHOWING THE AMOUNT OF THE MOST IMPORTANT CONSTITUENTS OF THE DRUG CORN SILK, AS FOUND BY RADEMAKER AND FISCHER

Constituent	Percent	Method used
Fixed oil	5.25	Petroleum spirit extract
Resin, Crystalline principle*, chlorophyll	2.25	Ether extract
Resin, Crystalline principle*, chlorophyll	3.25	Alchohol extract
Sugar, gum and extractive	19.50	Water extract
Albuminoids, phlobaphane, etc.	3.50	From alkaline solution
Salts and extractive	5.50	From acid solution
Cellulose	37.00	
Water	20.00	

*This crystalline principle was found to be maizenic acid.

Hare, Caspari, and Rusby[7] state that "The only specific constituents of corn silk which are definitely known, and upon which its activity may depend, are its resin and maizenic acid. The latter is crystalline

[6]Rademaker, C. J., and Fischer, J. L., Proximate analysis of Stigmata maydis. In Amer. Journ. Phar, Vol. 58, Fourth series, Vol. 16, pp. 369-370. 1886.

[7]Hare, H. A., Casperi, C., and Rusby, H. H., The National Standard Dispensatory. Lea & Febiger, New York, 2081 p., 1916.

and soluble in both alcohol and water, as well as ether. Although the attempt to obtain volatile oil was unsuccessful, there is some volatile substance, since the drug has a distinct odor. Hillan, by treating it with an alkali and then distilling, obtained a very small amount of a substance which was basic and afforded alkaloidal reactions."

Schweitzer[8] gives the following analysis of fresh and dry corn silk (Table V), and points out that the fresh and dry silks differ in the loss of phosphoric acid by the former and increase of potash in the latter.

TABLE V.—ANALYSIS OF FRESH AND DRY CORN SILKS BY SCHWEITZER

	Fresh silk	Dry Silk
Grammes of dry matter	35.50	7.70
Grammes of fine ash	1.21	0.23
Percent of fine ash	3.39	3.00
Silica	8.23%	7.93%
Ferric oxide	1.05%	0.31%
Phosphoric pentoxide	19.11%	14.25%
Lime	4.32%	8.25%
Magnesia	7.71%	6.98%
Potassa	42.27%	49.66%
Soda	1.06%	2.66%
Total	83.75%	90.04%
Missing	16.25%	9.96%

None of these writers gives a definite clue to the source of the odor in the silk unless it be the reference of Hare et al in which they attribute it to a volatile oil. Thus far the writer has been unable to find anything in chemical literature treating of the crystalline principle, maizenic acid, other than that it is a compound present in the styles and stigmas of Zea mays.

While the odor of corn silk apparently plays an important part in the attraction of the earworm moths to the corn plant, the writer is aware that other factors must be considered. It has been mentioned that when the silks are not present, eggs are deposited on the upper surface of the leaves and on the stalks, and certain preliminary experiments conducted in 1921 indicate that these also produce an odor attractive to the moths. In addition, various morphological characters must be taken into consideration. It has been observed repeatedly in the experimental plots that plants with smooth leaves and stalks have very few eggs deposited on these parts in comparison with plants having rough hairy surfaces. It is also worthy of note that throughout the wide range of plants on which the earworm oviposits, there is an apparent selection of rough, hairy surfaces. Collins and Kempton[9] consider the prolongation of the husk beyond the ear, the thickness and texture of the husk

[8]Schweitzer, P., Study of the Life History of Corn at its Different Periods of Growths. Mo. Agri, Exp. Sta. Bul. 9, pp. 3-78, 1889.

[9]Collins, G. H., and Kempton, J. H., Breeding Sweet Corn Resistent to the Corn Earworm. In Journ. Agri. Research, 11:549-572, 1917.

and the presence of husk leaves as characters associated with the amount of injury due to the earworm.

The practical application of physiological and morphological studies offers certain possibilities worthy of further investigations. The writer is of the opinion that such studies, carried on in co-operation with the agronomist, the plant breeder and the chemist, open the way for certain intensive investigations which ultimately will prove valuable in the development of control measures. Many of the characters associated with earworm activities can be changed or modified by careful breeding, and varietal studies of corn may reveal certain strains lacking in some of the characters attractive to the moths.

THE RELATION OF HARD AND ALKALINE WATERS TO THE PREPARATION AND DILUTION OF SPRAYS AND DIPS

By E. R. de Ong, *University of California*

The insecticidal ingredients of sprays and dips have been studied sufficiently so their properties are now beginning to be understood, but the water used as a dilutant and carrier for them has received almost no attention from the entomologist or the insecticidal chemist. And yet the composition of the water varies widely according to locality, and from season to season, in the same vicinity. In the Santa Clara Valley, California, where this study was made, a range in variation of 2300 per cent was found, while the hardness in the tap water from one water supply company increased 11 per cent from the first of May until the middle of August. The latter change may have been due entirely to a seasonal variation or to a shifting of the source of supply. This instance will serve, however, to show that the analysis of water from a supply company may vary materially during the year. Complete yearly records have not been kept but we would naturally expect that concentration of salts in underground water supplies or surface streams would increase during a long continued arid season, such as is common in California.

The soluble salts in water are now recognized as a source of danger in two ways, in the preparation or dilution of sprays and dips:—(1) by chemical reactions with the insecticidal or fungicidal materials, which neutralize their efficiency or form dangerous compounds. For example, the use of alkaline or saline waters with acid (standard) arsenate of

lead may produce a soluble arsenical dangerous to foliage. (2) By physical reactions, such as the breaking of oil or cresol emulsions in hard waters, which free the chemicals held in suspension and destroy the value of the mixture. We now recognize such dangerous or neutralizing reactions when hard and perhaps alkaline waters are combined with petroleum or cresol emulsions acid lead arsenate, fish-oil or whale-oil soap and nicotine sulphate.[1] The formation of a precipitate in combining lime-sulfur solution with hard water has also been noted and further study of this subject may reveal other dangerous or undesirable combinations.

Water containing considerable quantities of sodium salts, including chlorids, bicarbonates and carbonates is classified as "alkaline." When considerable proportions of magnesium or calcium either in the bicarbonate or sulphate form are present the water is termed "hard." Water hardness is of two types, "temporary" and "permanent." The first is the result of bicarbonate of lime or magnesium held in solution by an excess of carbonic acid. This form is largely broken up by boiling, the carbonic acid being freed and the normal carbonates of lime and magnesium precipitated. Permanent hardness is the condition resulting from the presence of sulphates or chlorids of lime and magnesium and to the carbonates still held in solution after boiling. This form cannot be overcome by heating. Both types can, however, be partially counteracted by the addition of chemical water softeners.

In this paper no distinction is made between the various kinds of hardness, whether due to bicarbonate, sulphate or chlorid of calcium and magnesium, as their reaction with soap is somewhat similar. Neither will there be any distinction drawn between temporary and permanent hardness of water, the total hardness alone being estimated.[2]

Determination of Hardness

The soap consuming or destroying power of the water sample was

[1]Imes, Marian, "Cattle Lice and How to Eradicate Them," U. S. Farmers' Bul. 909 p. 14.

[2]A survey was made in 1919 of a typical horticultural region in California to determine the distribution and degree of hardness existing in the local waters. Samples of water were collected from the entire district, the degree of hardness determined by tests with a standard soap solution, and modified formulas for making oil emulsions worked out for each type of water. A map of the surveyed region was then made, giving the location of each well tested. Surveys of this nature, giving definite information about local water supplies, will enable the orchardist to choose spray materials suitable to his water supply. The manufacturer of insecticides will find this information of value in preparing and marketing his materials, and to the horticultural officer it will serve as a guide for his recommendations and will assist in interpreting orchard troubles.

measured by means of a standard soap solution, the same method of determination being used throughout so that the results would be comparable. The test is made by measuring out 50 cc. of the sample water into a stoppered bottle and adding measured quantities of the soap solution, with frequent agitations, until a lather is formed which remains permanent for two minutes. Many of the samples were so hard that to avoid using quantities of the standardized solution,only 10 cc. of the sample water was combined with 40 cc. of distilled water. The soap solution should be added in small quantities, shaking vigorously after each addition, until a permanent lather is secured over the entire surface of the water while the bottle is lying on its side. The number of cc. of soap solution thus used, multiplied by 50, (when 10 cc. of water were used) would give roughly the parts per million of calcium carbonate or equivalent salts. This process of calculation is not entirely accurate but since comparative results are wanted and not an exact analysis, it serves the purpose. If desired, a more accurate estimate of the degree of hardness can be obtained by checking the number of cc. of soap solution used with the tables found in a standard text book on water analyses.[3] In Table 1 is given a summary of the water analyses made, the column at the left indicates the degree of hardness. The column of percentages, at the right, indicates the proportion in which this degree of hardness was present in the total of all analyses made.

TABLE I.—SUMMARY OF WATER ANALYSES

Soap solution used	Proportionate amounts
cc.	%
4-5	1.04
5-6	11.96
6-7	33.12
7-8	36.27
8-9	13.42
9-10	2.30
10-plus	1.89
	100.00

Considering the index number, 6 and below as indicating soft waters, this would mean that only 13 per cent of the total can be placed in this class. If those of moderate degree of hardness, viz. 6-7, are included, the total still falls below 50 per cent, leaving a remainder of 53.88 per cent of the waters classified as decidedly hard. The orchardists of this region find the hardness of the waters a real problem. A few haul soft water from nearby locations, the majority attempt

[3] "Standard Methods for Examination of Water and Sewage,"—published by American Public Health Association, 2d edition (1912) p. 33.

to soften the water with chemicals. In recent years insecticides compatible with hard water are coming into more general use which, with the growing use of dusts, may be the solution of the problem.

Water Softening

The removal of temporary hardness from water by boiling is too expensive to be applied in spray practice, hence we must depend on chemical water softeners. The function of such chemicals in making oil emulsions is:—(1) to react with the salts in the water and thus reduce the soap consuming power; (2) to aid in emulsifying the oil; and (3) to prevent the formation of insoluble calcium and magnesium soaps, these having a tendency to clog the spray nozzle.

The chemicals commonly used for this purpose are caustic soda (NaOH), Soda Ash (a crude product), Sal Soda ($Na_2CO_3 \cdot 10\ H_2O$), Lye (a mixture of caustic and carbonate of soda), commercial water softeners (caustics, carbonates and phosphates), and ammonia.

Caustic soda was found to be superior, in the locality where the survey was made, to any other form tested. This was especially true in very hard waters. The value of caustic soda in softening hard water is shown in Table II.

Table II.—The Value of Caustic Soda as a Water Softener
(Amounts based on 100 gallons of spray mixture)

Caustic Soda		Reduction of Soap Consumption		Difference	
Amount	Cost	Amount	Cost	Gain	Loss
Lbs.	$	%	$	$	$
1.6	0.25	40	.51	0.26	—
3.2	0.51	54	.69	0.18	—
6.4	1.02	59	.75	—	0.27

1. The amounts in this table were computed on the basis of eight pounds of soap per 100 gallons. Soap and soda valued at 16c a pound.

2. The results from the use of caustic soda cannot be estimated alone by the reduction in soap consumption. Its value as an aid in emulsifying oil must be considered although it is difficult to estimate.

Oil Emulsions and Hard Water

Petroleum oil is usually emulsified with the aid of fish-oil or laundry soap. It is a well known fact that the use of hard water in the household and laundry hinders the formation of lather. Similarly, hard water destroys oil emulsions. In both instances, the soluble soda and potash soaps, which are unaffected chemically by soft waters, react with the calcium and magnesium salts in the hard water and form an insoluble soap. This insoluble soap is of no value in making

emulsions or to increase the cleansing power of the laundry water and hence is a waste. Therefore, if a hard water is used in preparing or diluting an emulsion, the hardness must be removed by the use of a preliminary softening agent or by sufficient soap to produce the same result. A slight amount of alkali in the water does not materially retard the action of soap but if excessive quantities of sodium salts are present, the formation of lather is checked.

TABLE III.—SUMMARY OF MODIFIED FORMULAS FOR MAKING OIL EMULSIONS WITH WATERS OF VARYING DEGREES OF HARDNESS
(Amounts based on 100 gallons of spray mixture)

	Crude Oil					Distillate Oil			
	Caustic Soda		Soda Ash			Caustic Soda		Soda Ash	
Soap solution used	Amt. of caustic soda	Amt. of soap	Amt. of soda ash	Amt. of soap	Soap solution used	Amt. of caustic soda	Amt. of soap	Amt. of soda	Amt. of soap
C. C.	pounds	pounds	pounds	pounds		pounds	pounds	pounds	pounds
4–4.9	0.5	2.47	—	—	5–5.9	0.75	5.5	3	5.5
5–5.9	0.66	4.83	1.5	6	6–6.9	0.5	5	2	5
6–6.9	0.50	6.33	2.0	5	9–9.9	1.5	5		
7–7.9	0.8	6.83	2.2	7.8					
8–8.9	1.	7.0							
9–9.9	1.	7.0							

The amounts of water softener and soap given are averages of trials which have produced satisfactory emulsions in a number of waters with the degrees of hardness given in columns 1 and 6. These figures indicate the amounts of soap and softener required for making emulsions with water of a similar type, or the softener alone, if prepared emulsions are used which are not adapted to hard water.

Some variation from the amounts of softener and soap given will, of course, be necessary for different types of water and oil. The data given are simply the results from experiments where satisfactory emulsions were secured and hence may be taken as a basis from which to work. It should be remembered, however, that changes in the type of oil, water or softener used means a new experiment, and should be considered as such

THE RELATION BETWEEN ARSENICAL INJURY AND ALKALINE AND HARD WATERS

It has been shown by Headden[4] and Hayward & McDonnell[5] that the soluble salts commonly occurring in waters, (notably sodium chlorid, carbonate and sulphate) if present in more than small quantities, may exert a solvent action on lead arsenate. Headden states[3], "that he considers it unsafe to use alkali water as a carrier for lead arsenate,"

[4] Headden, Wm. P., "Arsenical Poisoning of Fruit Trees." Colo. Bul. 131, p. 220.
[5] Hayward & McDonnell, "Lead Arsenate," U. S. Bu. Chem. Bnl. 131, pp. 46-49.

and cites experimental data where sodium sulphate and particularly sodium chlorid had acted as a solvent for lead arsenate.

Hayward & McDonnell reported experimental data showing "that lead arsenate applied in water containing twenty parts of chlorin per million had caused more injury to peach foliage than when applied with distilled water, and that the addition of 10 to 40 grams of sodium chlorid or sodium carbonate per gallon had caused a heavy increase in arsenical injury." The usual reaction between acid lead arsenate and chlorin is the formation of a soluble arsenate and a complex lead salt. The sodium arsenate goes into solution readily in atmospheric moisture, and is then absorbed by the plant and causes burning.

To determine what salts are present and their proportions in waters with varying degrees of hardness, the following analyses were made of typical water samples.

TABLE IV.—ANALYSES OF SOFT AND HARD WATERS

Constituent	Parts per million		
	(1)[1] Very soft	(2) moderately hard	(3) very hard
Calcium (Ca)	40	50	25
Magnesium (Mj)	5	20	100
Sodium (Na)	32	52	384
Bicarbonate (HCO_3)	183	256	646
Sulphate (SO4)	10	50	150
Chlorin (C1)	10	40	440
HYPOTHETICAL COMBINATIONS OF ABOVE ANALYSES			
Sodium Sulphate (NaSO4)	15	74	221
" chlorid (Na C1)	33	66	726
" bicarbonate (NaHCO3)	51	17	109
Calcium bicarbonate ($Ca(HCO_3)2$)	160	200	100
Magnesium bicarbonate ($Mg(HCO_3)2$)	30	120	600

[1]The amount of soap solution used in neutralizing the hardness of the three samples is, — (1) 4. 9, (2) 6. 7, (6) 14. 0.

It will be noted that the chlorin content of only the first one is less than twenty parts per million—the factor which was associated with arsenical injury in Hayward & McDonnell's experiments.

All hard waters do not necessarily contain chlorin, but they may have excessive quantities, as already mentioned, one of the common forms in which chlorin occurs is sodium chlorid, which is a characteristic component of saline rather than that of hard waters. A study of eighty analyses of California waters showed that only 14.8% of the total were apparently safe for use with acid arsenate of lead, when applied to tender foliage. These samples cannot be considered as typical because there is usually some suspicion regarding a water be-

fore an analysis is asked for. They do show, however, a large proportion of water unsafe for use with this common type of arsenical. When it becomes necessary to use alkaline or hard waters in spray work, the safest plan is to substitute basic arsenate of lead for the acid type. Milk of lime combined with acid arsenate of lead tends to prevent danger of this kind.

Conclusions: Hard and alkaline waters form dangerous combinations with many forms of insecticides.

Softening of hard water with chemicals is only partially successful. Water softening plants, with a capacity sufficient for supplying a spray outfit and for domestic purposes also, may be installed at a cost of a few hundred dollars.

The use of dusting materials, where practical; in place of liquid sprays is desirable, in that the user is inependent of the type of water found locally.

Insecticides compatible with the salts commonly found in waters are desirable and in many instances will prove a satisfactory solution of the subject. Examples of such substitutions are, basic arsenate of lead instead of the acid (standard) type, arsenical dips in lieu of cresol preparations, and the stable oil emulsions which are made for use in waters.

RELATION OF MOISTURE TO INGESTION OF POISON BY THE COTTON-BOLL WEEVIL

By D. C. WARREN, *Georgia State Board of Entomology*

Considerable attention has recently been given to the problem of poisoning the cotton boll weevil by the use of calcium arsenate. The dusting method has been used and has given profitable results.

In Bulletin 731, United States Department of Agriculture, B. R. Coad concludes that "success in poisoning was due to ingestion by the weevil while drinking." He found that "only a very light mortality would result from tests where the plants were kept absolutely dry after poisoning; but as soon as moisture was introduced the mortality increased greatly."

During the summer of 1919 Wilmon Newell and Eli K. Bynum of the Florida State Plant Board carried out a series of experiments testing out the relation of dew or rain to the effective use of arsenates for poisoning the boll weevil.[1] Newell and Bynum carried out field cage

[1]Journal of Economic Entomology, February 1920.

experiments in which some of the cages were covered so as to prevent the formation of dew on the plants and in other cages the dew was allowed to form on the plants. In each case the plants were dusted in the same manner with calcium or lead arsenate. A slightly higher mortality was obtained in cages where the dew was not allowed to form.

Circular 38 of The Alabama Polytechnic Institute by W. E. Hinds gives briefly the results of tests conducted by the writer under the direction of Dr. Hinds during the summer of 1918. These were laboratory and field tests in which moisture was applied or allowed to form on the plants in one case and excluded in another. Here a slightly higher mortality was obtained on poisoned plants where the moisture was excluded and exclusion of moisture from the checks had no effect upon the mortality.

In view of the difference of opinion upon the question of whether moisture is essential for the weevil to ingest the poison, the writer considered it worth while to conduct further experiments upon the problem. Accurate information upon this question is essential in applying control measures for this insect.

Location of Experiments and Materials Used

The experiments here given were conducted at Valdosta, Georgia at the Sea Island Experiment Station of the Georgia State Board of Entomology during the summers of 1920 and 1921. The cages used were 3x3x4 feet and 4x4x6 feet. Vigorously fruiting plants were selected for caging and the bottom of the cages was covered with heavy paper so as to make the dead weevils readily seen. The calcium arsenate used was of the chemical constitution recommended for cotton dusting. A fairly heavy dosage of poison (about 10 pounds per acre) was applied to the caged plants.

Experiments Comparing Mortality from Feeding during the Period of the Day in which there is Dew on the Plant with the Period during which the Plant is free from Dew

These experiments were carried out in a manner somewhat different from those previously conducted in testing the relation of moisture to ingestion of the poison by the weevil. Here, mortality, from feeding during the period in which the dew remains on the plant, was compared with mortality from feeding during the period in which there is no dew on the plant. Thus the mortality among weevils which fed upon poisoned plants from 6 P. M. to 8 A. M. was compared with the mortality among weevils which fed upon poisoned plants from 8 A. M. to 6 P. M. The

weevils feeding in the presence of dew were removed in the morning (after feeding during the night) to fresh unpoisoned plants and those feeding in the absence of dew were removed (after feeding during the day) to fresh unpoisoned plants and mortality records were kept. In each case for comparison, check cages were run on unpoisoned plants. This should give an accurate and critical test of the role of dew in poison ingestion by the weevil. The only inaccuracy which enters in is the fact that those weevils feeding in the absence of dew have only a feeding period of 10 hours against 14 hours for those feeding in the presence of dew but it will be seen that this did not affect the results. It may not seem fair to compare night feeding with day feeding but if we assume that dew is necessary for the ingestion of the poison, this is the period in which the weevil has an opportunity to drink the dew. In each case the weevils were placed on the caged plant a few hours before applying the poison in order to allow them to adjust themselves to the plant. Cages of the size 3x3x4 feet were used in these experiments. The results of these experiments are given in table I.

TABLE I.

	Total No. weevils used	Mortality first 24 hours	Second 24 hrs.	Third 24 hrs.	Total mortality	Mortality Percent.
Day feeding	294	38	53	41	132	45
Night feeding	320	38	47	28	113	35
Check	301	16	34	25	75	25

A record was kept of the mortality for 72 hours after the poison had been applied, the first 10 or 14 hours of which were spent on the poisoned plant by the weevil. It will be seen from the table that there was a greater mortality (45%) among the weevils which fed during the period in which there was no dew on the plant although they remained on the poisoned plant a much shorter period than did the weevils feeding in the presence of dew (mortality 35%). The results given in table I were for the season 1920 and to further check the results the experiment was repeated in 1921 under more carefully controlled conditions.

It was found during the summer of 1920 that there was considerable difference in natural mortality among collections of weevils made in different fields or at different periods in the same field. It is probable at the late season when these experiments were conducted, there was considerable overlapping of broods so that, from one collection one might obtain only newly emerged weevils in which the natural mortality would be low, while from a nearby field one might obtain comparatively

old weevils in which there would be a high rate of mortality. So in the 1921 experiments care was taken to run the experiments in series so that the weevils from a single collection were equally distributed among the day feeding, night feeding and check cages. Also instead of removing the weevils, after their feeding period on the poisoned plant, to caged unpoisoned plants, they were placed in the insectary in gause-covered lantern globes with fresh cotton squares as food. In this way the difficulty from ants carrying away the dead weevils was avoided. The results of the 1921 experiments are given in table II.

TABLE II*

Test no.	Day feeding			Night feeding			Check		
	No. weevils used	No. killed	Percent killed	No. weevils used	No. killed	Percent killed	No. weevils used	No. killed	Percent killed
1	51	48	94	37	27	73	42	12	29
2	85	75	88	86	57	66	102	27	26
3	120	99	82	112	103	92	142	79	56
4	93	83	89				108	14	13
5	80	51	64	96	49	51	44	10	23
6	92	90	98				100	35	35
Total	521	446	85	331	236	71	528	177	34

*The blank spaces in the table are due to rainfall ruining this portion of the series of experiments.

Here the mortality was recorded for a period of 96 hours after the poison had been applied to the plant upon which the weevils were feeding. Here the mortality during the 96 hours following the application of the poison in the case of the weevils feeding in the absence of dew was 85 percent and for the weevils feeding in the presence of dew was 71 percent. Here again the death rate was higher among the weevils remaining on the poisoned plant the shorter period and during the period when they could obtain no moisture.

It is also of interest to note in this connection that a rather high percent of mortality was obtained from a very short feeding period.

CAGE TEST COMPARING CONDITIONS WHERE DEW WAS EXCLUDED WITH CONDITIONS OF NORMAL DEW FORMATION

These tests are the same type as were carried out by Newell and Bynum. The writer made a few of these tests to check up his own results obtained from attacking the problem from another point of view. Cages size 4x4x6 feet were used in these tests. The experiments were run in the following series: one cage was poisoned and covered, one was poisoned and left uncovered, one was unpoisoned and covered, and one was unpoisoned and left uncovered. Canvas covers were used for the cages and they were covered only during the period of dew formation

(about 7 P. M. to 7 A. M.) Experiments with which rain interfered are not recorded. Table III gives the results of the experiments.

TABLE III

	Total No. weevils used	Mortality first 24 hours	Second 24 hrs.	Third 24 hrs.	Total mortality	Mortality percent
Covered poisoned	200	10	46	56	112	56
Uncovered poisoned	200	10	32	62	104	52
Covered check	200	3	5	9	17	9
Uncovered check	200	2	10	7	19	10

It will be seen from table III that the exclusion of dew from the poisoned plant had no effect upon the rate of mortality. The percent killed during the period recorded is so near alike in the two, that the difference is probably due to chance variation. Also by comparing the covered and uncovered checks it will be seen that covering had no effect over the mortality.

CONCLUSIONS

So considering the results discussed here and those obtained by other investigators, it seems that it has been conclusively shown that the cotton-boll weevil is poisoned by ingestion of poison with its food rather than by drinking the poisoned dew. This conclusion has nothing to do with the time of day when the poison should be applied, for it is a well established fact that better results can be obtained from applying poison while the plant is wet with dew.

OBSERVATIONS ON INSECTS ATTACKING SORGHUMS

By WM. P. HAYES, *Assistant Entomolgist*
Kansas Agricultural Experiment Station[1]

The following observations were made during the past few years in connection with a study at this station of insects attacking sorghums. The sorghum crop in Kansas is on the whole remarkably free from insect pests, escaping almost entirely the ravages of the sorghum midge and stalk-borers common in southern regions. In the selection of forage crops in western Kansas, consideration must be given to possible injury by grasshoppers and chinch bugs. Sudan grass and milo are much

[1]Contribution from the Entomological Laboratory, Kansas State Agricultural College, No. 71. This paper embodies the results of some of the investigations undertaken by the writer in the prosecution of project No. 92 of the Kansas Agricultural Experiment Station.

relished by grasshopppers, while kafir, feterita, and sweet sorghums are only eaten by them when other food plants are scarce. Chinch bugs attack milo and Sudan grass, concerning which more will be said later, and other sorghums to a lesser degree. It is obvious that with 2,353,324 acres of sorghums in the state, valued at $48,507,013.00,[2] any pest seriously attacking the crop could cause considerable damage.

Insects Attacking the Head

Sorghum Webworm.—The most serious insect attacking the 1921 crop was the sorghum webworm heretofore unreported as an enemy of sorghums in Kansas. Reports and specimens received from the southern part of the state showed that a lepidopterous larva was attacking the heads of kafir in damaging numbers. Specimens sent to Washington were determined as *Celama (Nola) sorghiella* Riley.[3]

The first report of damage was received Sept. 24, from Bourbon County, in which the county agent reported the larva eating the grain from kafir heads but not injuring the leaves or stalk. At the time of writing they had destroyed 13 acres. A second complaint from a Bourbon County farmer reported injury to cane as well as kafir, and stated that a heavy rain had apparently destroyed many of the worms.

In Chautauqua County, as high as 40 percent of the crop was damaged in some fields and the county agent in Cherokee County reported 100 percent injury. A survey of the vicinity of Manhattan, Riley County, revealed only one larva found on a kafir head and no reports were received from points in other than southeastern Kansas. Farmers in the infested area say that the appearance of this insect is more or less periodical, causing injury and then not being heard of again for several years.

In Cherokee County, an experimental field operated in cooperation with the Department of Agronomy contained the following varieties: Standard Blackhull Kafir, Pink Kafir, Sunrise Kafir, Feterita, Kansas Orange Cane, and Sumac Sorghum, all of which were attacked by the webworm.

Forbes (1905, p. 169) mentions that Ashmead found the species on tassels of corn. In 1908, the Yearbook of the U. S. Department of Agriculture (p. 570) states that this species breeds in heads of sorghum from Virginia to San Antonio, Texas.

Little is known of the habits of this species. Riley (1882, p. 187) first described the species from specimens received from Alabama where

[2]Figures from 22d biennial report of the Kansas State Board of Agriculture 1920.

[3]Determined by Mr. Carl Heinrich through the courtesy of Dr. L. O. Howard.

they were injuring sorghums. He likewise described the larval and pupal stages. The nature of the damage done in Kansas is similar to that described by Riley which is here quoted.

"The sorghum heads sent were, for the most part, so interwoven with silk as to form a compact mass, in which was profusely mixed the whitish excrement of the larva. Running through the mass were numerous delicate tubes, forming channels, through which the larvae passed from one seed to another unexposed to the attacks of parasites. The kernels of the grain were sometimes entirely eaten, but in general were only partly destroyed, the germ, however, seeming to be the portion of the seed preferred, as in almost every instance it was eaten. The larvae were very active when disturbed, and left the heads when ready to transform, spinning small silken cocoons upon the surface of the ground or in some sheltered place. The cocoons were about 7 mm. (a little more than a quarter of an inch) in length, somewhat thickest at the anterior end, and with a small opening at the posterior end, through which the last larval skin was partially pushed. They were made out of delicate, closely spun white silk, firmly fastened to the object selected by the larva for attachment, and were covered with particles of wood, bark, or excrement, so that they were readily recognized. The moths issued in late July or early August, a week or more after spinning of the cocoons."

At the time of writing—Dec. 18, 1921—the specimens are in the larval stage and it is possible that the species hibernates in this stage in Kansas. There is a slight possibility of two or more broods in Kansas and that some undetermined food plant offers sustenance to the species until the sorghum heads appear in the fields. The Yearbook of the U. S. Department of Agriculture for 1906 (p. 510) reports the species attacking the heads of timothy at Arlington, Va.

It was stated by southern Kansas farmers that the larvae "make sores or a kind of breaking out on the skin wherever they happen to crawl on a person." This rash produced a more or less severe itching and several farmers were reported unable to harvest sorghum crops because of poisoning received by coming in contact with the worm when attempting to harvest their crop.

CORN LEAF APHIS.—McColloch (1921. p. 91) reported injury to the 1919 crop of sorghums in Kansas by *Aphis maidis* Fitch. Certain fields in the western part of the state were ruined by the species which had caused, in the heavily infested heads, badly shriveled grain. The question arose as to the effect of this injury on the germinative powers

of the grain. Accordingly, a series of standard Blackhull kafir tests were planted, using uninjured grain as controls with 100 seeds in each test. These results are found in Table I.

TABLE I.—PERCENTAGE OF GERMINATION OF SEEDS INJURED BY APHIS MAIDIS.

Test number	*Percent of Germination*	
	Uninjured grains	Injured grains
1	78	51
2	65	50
3	75	75
4	32	22
5	47	37
6	28	14
7	17	19
8	12	3
9	9	10
10	9	42
11	22	16
12	20	28
Average	34.50	30.58

Several thousand germination tests made by the writer in connection with studies of the insects attacking the seed of sorghums have shown the percentage of germination to be very low in check plots. The results of Table I show wide discrepencies, but an average of 12 plots shows a reduction of nearly four percent in vitality of the seeds. Such a reduction in seeds with naturally low vitality must be considered important.

CORN EARWORM.—Sorghum plants are generally regarded as incidental food plants of *Chloridea obsoleta* Fab. and little is found in the literature concerning it. Mally (1893, p. 18) found volunteer sorghum plants riddled by insects. He attributed some of this injury to the corn earworm, but thought most of it was due to cutworms. Quaintance and Brues (1905, p. 17) mention the corn earworm eating the tender central bud and green seeds of sorghums. Aside from such scanty references, no large amount of injury to sorghums has been charged to this species.

During the past summer (1921) the earworm was unusually abundant on sorghum plants, feeding at first on the leaves and curl and later on the green heads. No variety of sorghum was noted to have escaped the attack of the worms. In 1911 the earworm appeared in injurious numbers on kafir plants at Herington, Kansas, at which time as high as 8 to 10 worms could be found feeding on the green heads, and many moths were noted flying around the plants at night.

COREIDAE—As a minor pest attacking the head before maturity, *Leptoglossus zonatus* Dall. may be mentioned. It was noted sucking the sap of a green kafir head. Forbes (1905, p. 197) reports injury to

sorghum by another species of the same genus, *Leptoglossus phyllopus* Linn.

ANGOUMOIS GRAIN MOTH.—The granary pest, *Sitotroga cerealella* Oliv. was unusually abundant in sorghum fields during the 1921 growing season, causing considerable damage to all varieties of sorghums, and much loss can be expected in the stored crop. Injury to sorghums in the field is quite similar to that of other grains.

INSECTS ATTACKING THE STALKS AND LEAVES

CHINCH BUGS.—Sudan grass is relished by chinch bugs (*Blissus leucopterus Say*) and many bugs seek their winter quarters at the crown of the plants. An effort was made during the winter of 1920-1921 to ascertain whether Sudan grass offered favorable protection for the bugs. Accordingly, counts were made during the fall and winter in clumps of Sudan grass in which the stalks had been cut and in clumps with stalks left standing. No noticeable difference was observed between the cut and uncut as a means of protection. Owing to the mild winter and comparative scarcity of bugs, counts did not show large numbers in the clumps. During October, as high as 19 bugs were noted in individual clumps; in November, as many as 27, and 17 in February. Chinch bugs were more numerous the past summer (1921), and counts in November showed as many as 74 bugs to a clump.

Observations were made on the susceptibility of milo to chinch bug injury. To some it is a matter of common observation that young milo plants are more seriously injured by chinch bugs than any of the sorghums. Counts were made on the Kansas Experiment Station 1921 crop of sorghums. In the variety tests, out of 24 varieties, only three—Dwarf Yellow Milo, White Milo, and Progressive Kafir—showed dwarfed, stunted plants caused by bug injury, although many of the other varieties showed some injury to the lower leaves.

In these plots, Dwarf Yellow Milo exhibited the most injury, followed by White Milo and Progressive Kafir in the order named. In the breeding plots, White Milo showed as high as 25 per cent (by count) of injury per row, while Dwarf Yellow Milo showed only 20 per cent. Two interesting points were noted in this plot. Milo crosses in rows adjoining the injured milo plants were untouched by the bugs and showed luxuriant growth, attributed by plant breeders to what is known as 'hybrid vigor.' Some plants of volunteer corn growing between the rows of injured milo had but few bugs on them, and showed no damage, indicating that the bugs in this case preferred the milo to corn.

GREEN BUGS.—The green bug (*Toxoptera graminum* Rond.) occasionally injures Sudan grass as well as all other varieties of sorghum. In 1916, in western Kansas, this species did considerable damage, causing infested plants to turn yellow and die. Further injury by the bugs was checked by a dashing rain.

INSECTS ATTACKING THE PLANTED SEED

KAFIR ANT.—One of the most injurious pests of kafir is the tiny-thief-ant (*Solenopsis molesta* Say). The habits of this species have been rather fully discussed by the writer (1920). Mention was made at the time that no mating flight had been noted in Kansas, although citations were made of its occurrence elsewhere. Since then the following observations were noted, which may be of interest in connection with the mating habits of the species.

"A general mating flight of *S. molesta* occurred at 5:00 P. M., July 27, 1920, and until dusk the air contained thousands of individuals. Females were the more abundant. Mating occurred in the air. Mating pairs were seen to alight on the ground where the male would release himself at once and immediately take to flight again, evidently pursuing another female. Sometimes the female would fly and at other times would at once begin to shed her wings. This was done by kicking them off on one side with the rear leg of that side. The front wing came off first, then the other. Then turning onto the side of the body that had lost the wings, it would kick off the other wings in the same manner. This occupied only about one minute. Other females were seen to alight without males, and at once shed their wings. These were perhaps those individuals that had mated and taken to the air again. One such was seen to alight on the leaf of a sorghum plant and shed its wings on the leaf and then start to crawl down to the ground. The wingless queens crawled over the ground and sought cracks in the soil in which to enter. The night of July 25-26, 3.19 inch rain fell and the soil was very damp. A jelly glass in the laboratory containing "sex-larvae" collected June 24, 1920, had transformed and 12 males were observed running about actively on the surface of the soil in the jelly-glass cage. During the flight, one queen was observed near the crater opening of a *Lasius* colony. It was attacked by the *Lasius* workers and carried helpless into the opening of the *Lasius* nest. July 28, 1920, 9:30 A. M., all of the queens flying last night have sought shelter under corn leaves, stalks and clods in the corn and kafir plots. Three winged males were found walking on the surface of the soil. One male was seen with his

wings caught on the moist surface of the sorghum leaf. Several wingless queens were found under leaves, stalks, etc. Discarded wings were abundant on the surface of the soil. A spider was found carrying a dead, wingless queen on the surface of the sorghum plots. Aug. 5, 1920. A colony was found at the college farm in a corn field which contained a number of winged males, showing that not all participated in the flight of July 27."

During the flight, twelve of the newly mated queens were collected and placed in soil in jelly glasses. By Aug. 19, some of the queens had as high as 12 half grown larvae in a small chamber hollowed out in the soil, and on Sept. 25 a few workers were noted in several of the colonies. Nine of these queens successfully passed the winter in a cave and began to build up their colonies the next spring and summer. Seven colonies surviving are now passing their second winter in the cave. A second flight was observed by Mr. J. W. McColloch on July 5, 1921. This flight was 22 days earlier than the 1920 one, and as in the case of that flight, was preceded by a heavy rain.

THE SEED CORN MAGGOT.—The seed corn maggot, *Hylemyia cilicrura* Rd. (*Phorbia fusciceps* Zett.) was found by Mr. E. G. Kelly seriously damaging planted kafir seed at Olathe, Kansas. A single repellent test conducted with tobacco compounds, using nicotine resinate, tobacco oil, and nicotine sulphate (40%), on Commercial White corn, indicates that they may be of some value. The nicotine sulphate which had a strong odor at the end of the test had not injured germination, and in comparison with the check, had repelled the larvae. Further tests are desirable to make this conclusive.

Pheidole sp. (Hym.).—A species of *Pheidole* did considerable damage to planted sorghum as well as corn seeds at Manhattan during May and early June. Their work was evident on the surface by small mounds which in most cases were covered with fine white particles of the seed carried to the surface. The damage is quite similar to that of *Solenopsis molesta*, the ants evidently preferring the oily parts of the seed, leaving the starch in finely chopped bits. As high as 21 percent of injury was noted (Red kafir) and 19 varieties were attacked.

LITERATURE CITED

RILEY, W. V.
1882—Report of the Entomologist. Rept. Comm. Agri. for 1881 and 1882—p. 187-189.

MALLY, F. W.
1893—Report on the Boll Worm of Cotton (*Heliothis armiger* Hübn.) U. S. Dept. of Agri., Div. Ent., Bull. 29 (old series) pp. 1-73.

QUAINTANCE, A. L. and BRUES, C. T.
1905—The Cotton Bollworm. U. S. Dept. of Agric., Bu. Ent. Bull., 50, pp. 1–155.
FORBES, S. A.
1905—A Monograph of Insect Injurious to Indian Corn, Part II. Twenty-third Rept. State Ent. Ill., p. 169.
HAYES, W. P.
1920—*Solenopsis molesta* Say (Hym.). A Biological Study. Kans. Agri. Exp. Sta., Tech, Bull., 7, pp. 3-55, figs. 11.
McCOLLOCH, J. W.
1921—The corn Leaf Aphis (*Aphis maidis* Fitch) in Kansas. Journ. Econ. Ent., 14:89-94.

CONTROL OF THE STRAWBERRY LEAF-ROLLER IN THE MISSOURI VALLEY

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INTRODUCTION

This paper is the result of work done in Kansas in 1917 and 1918, and in Iowa in 1919, by the writer while engaged in truck-crop insect investigations in the Bureau of Entomology, United States Department of Agriculture. The Strawberry leaf-roller (*Ancylis comptana* Fröhl.) in the adult stage is a small reddish brown moth with intricate markings; the larva, a nearly smooth caterpillar, slender, and reaching a maximum length of one-half inch. The larvae vary from light green to dark olive green. The species is distributed over all strawberry growing regions of North America.

The life-cycle stages in summer in southern Kansas are about as follows: egg, 6 days; larva, 22 days; pupa, 7 days. Several days are required for the pre-oviposition period, and a generation in summer required about 40 days. Stages are much longer in cool weather. R. L. Webster[1] has secured an average of 75 eggs per female in the insectary, and an average adult life of 10 days. The pale green egg is deposited on the leaf; the larva feeds, usually on the under surface, for about a week after hatching. It then draws the leaf together and webs it up, working on the upper surface. In this protected situation, it feeds and grows, and if not disturbed, will reach the adult stage before leaving. It never eats through the leaf, but injures it by webbing and feeding on the surface.

The nearly grown larva hibernates in the leaves and pupates early in the spring in Kansas, emerging during April. It seems likely that four generations occur, but that some of the last larvae of the third

[1]Webster, R. L., 1918. Journal Econ. Entom., Vol. 11, pp. 42-45.

generation hibernate before pupating, and that in long seasons a small fifth generation may develop. Adults of the first generation appear by June 1, and those of the second generation begin appearing about July 10. In Iowa there are at least three generations and probably a partial fourth. The cool weather of late September and October appears to cause a cessation of pupation, and the larvae then present hibernate. After the intermission between the over-wintered and the first generation, all stages can generally be found in the field at any time until fall, though more abundant at some times than others. This is due to length of oviposition period and variation in development.

Injury

Usually only a few larvae may be found in a strawberry patch, and injury is very slight. In many cases, however, more or less damage is suffered by the plants, and occasionally a patch is found in which many or all of the plants have been killed. More than one larva to a plant will injure it noticeably. Injury is more severe in dry weather, since the plants have then less power of recovery. The writer has been unable to find the species in Kansas on any plant other than strawberry.

This leaf-roller shows marked fluctuations in numbers, due to numerous parasitic enemies of several hymenopterous and dipterous species. Winter cold, lack of food when larvae are numerous, and disease also reduce its numbers.

Outbreaks are usually rather sudden, local and short, lasting a season or less, though the species may be troublesome for several years in one locality. The grower can therefore undertake control measures, knowing that if the plants can be protected for the time, the leaf-rollers will soon diminish in abundance. The first generation is usually most injurious, but later generations often do considerable damage, especially in new plantings.

Control Problem

Control by spraying is based on coating the leafage with poison, which will kill the young larvae as they begin to feed. The older larvae are usually safe in their folded leaves. As all stages are present together during the summer, larvae and pupae present at the time of spraying will mature and deposit eggs for several weeks afterward. Some of these eggs will be deposited on unpoisoned foliage, since the plants will have put forth new leaves and rains will have washed off some of the poison. These conditions make it impossible to secure complete control with a single application under field conditions. When the first generation

of larvae, all about the same age, are present, it would seem that nearly all might be killed by a single spray at the time of hatching; but at this time rains are frequent and new leaves are being formed rapidly, so that control is actually more difficult then later. Complete control would necessitate keeping all foliage continuously coated with poison for several weeks. Before experiments were conducted, it seemed doubtful if enough larvae could be killed to reduce injury; but it was found that a single spray application gives the leaf-roller a substantial check and benefits the plants decidedly if they are being injured.

RESULTS

The tests made by the writer were all on plots of less than one-half acre. Since the point to be tested was whether any arsenical would give satisfactory control, dry lead arsenate at the rate of 2 pounds to 50 gallons of water was applied, using a compressed-air sprayer. Half the strength would probably do just as well. In all except the first two tests, resin soap was used as a "spreader" and "sticker." In each case equal sprayed and unsprayed areas were counted over. Some difficulty was encountered in finding infestation severe enough for experiments. In plots 1, 2 and 4 some larvae were present at spraying time but had disappeared before counts were made.

TABLE OF RESULTS

Expt. No.	Locality	Date of spraying	Date of counts	Results	Percentage of Control
1	Wichita Kans.	May 2 1917	June 13	No leaf-rollers on sprayed or unsprayed area	—
2	Ogden Kans.	Aug. 11 1917	Sept. 8	No leaf-rollers on sprayed or unsprayed area	—
3	Wichita Kans.	Sept. 13 1917	Sept. 28	On sprayed area, 41 leaf-rollers on unsprayed area 120	66%
4	Troy Kans.	Jun. 25 1918	Jul. 16	No leaf-rollers on sprayed or unsprayed area	—
5	Muscatine Iowa	May 2 1919 and May 7	June 2	On sprayed area, 55 folded leaves, on unsprayed area, 125 folded leaves	55%
6	"	July 16 1919	Aug. 8 1919	On sprayed area, 4 leaf-rollers, on unsprayed area, 19	79%
7	"	July 16 1919	Aug. 5 1919	On sprayed area, 8 leaf-rollers, on unsprayed area, 24	67%
8	"	Aug. 14 1919	Sept. 2 1919	On sprayed area, 2 leaf-rollers, on unsprayed area, 5	60%

A weighted average of the above gives 63% control from a single spray.

The only large-scale spraying against the leaf-roller observed by the writer was that done in 1918 by Mr. F. W. Dixon at Holton, Kans., on about 60 acres of strawberries on his nursery farm. Leaf-rollers were first noticed in numbers in the fall of 1917, and began to be very injurious the following spring. Injury was aggravated by drouth, which was also

favorable to spraying. Mr. Dixon used a modern orchard sprayer with a row attachment. Three applications of lead arsenate were made; about June 15, July 20 and August 15, respectively. Several acres were left unsprayed the first time and nearly all plants in this area were killed. Many larvae were present on the sprayed area, but their numbers were so reduced that little injury was accomplished. This first application, in the writer's belief, saved a large portion of the plants. The second and third sprays were applied to all the strawberry acreage. The leaf-rollers were held in check all season. Though some larvae were always present, serious injury was averted. They became scarce by fall and were not troublesome in 1919. These results in large scale spraying by a grower are very gratifiying, especially considering the unusual severity of the outbreak. Although 100 percent control was not achieved, injury was effectually checked.

Recommendations

Lead arsenate with a soap spreader is well adapted to control of the leaf-roller, adhesiveness being especially desirable. Any fairly good spraying apparatus will do to apply it, and underspraying is unnecessary. The grower should spray only when the insect threatens to assume injurious numbers. One or two applications as the plants begin blossoming will reduce the numbers of the first generation, and probably also of saw-fly larvae if present. Growers will be reluctant to spray after berries begin setting. Should injury continue after harvest, further sprays should be applied. Mowing and cultivating aid in control where practiced, but are not always sufficient. Leaf-rollers should not be allowed to injure the plants during summer and fall, as the plants which will bear next year's crop are then developing. New plantings are very liable to injury late in the season.

Since one application gives about two-thirds control, several at short intervals should bring an outbreak to an end so far as serious injury is concerned. There is little advantage in spraying at intervals of less than two weeks in dry weather in summer and fall, but in rainy weather shorter intervals are better. Sprays a month apart during the summer have given practical control of the worst outbreak the writer has seen, though more frequent applications would probably have given more nearly perfect control.

Spraying as outlined throughout the season, both before blossoming and at intervals from midsummer until early fall, will protect the crop against unusual outbreaks. Usually, however, such frequent spraying

will not be necessary; in many cases it will not be needed at all, and in others one or two applications will suffice to protect the plants until the outbreak subsides. Spraying is not necessary nor profitable when leaf rollers are few, but it is an effective means of combating them when they rise to injurious numbers.

HOST PLANT SELECTION BY HESSIAN FLY[1] (*PHYTOPHAGA DESTRUCTOR* SAY.)

By W. B. CARTWRIGHT, *Scientific Assistant*,
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In connection with the Hessian fly investigations at Centralia, Illinois, for the Fall of 1921, two sowings each of wheat, barley, rye, and oats were made to determine the relative attractiveness of these grains to the adult flies for oviposition and to obtain comparative data on larval infestation. Identical preparations were made for both series with respect to orientation of the plots and the date of sowings.

I. Sowing September 1.

Plants of this sowing appeared above ground on September 10. On this date fifty plants from each plot were marked and numbered for daily examination during the emergence period of the Hessian fly. The eggs found on these plants were carefully removed and recorded as found. The counts for the series are shown in Table I.

TABLE I—DAILY EGG COUNTS

Date	Wheat	Barley	Rye	Oats	Total
Sept. 11	15	7	2	0	24
14	7	0	0	0	7
15	1	0	0	0	1
24	1	0	0	0	1
28	56	0	23	3	91
29	85	23	142	7	257
30	58	0	7	0	65
Oct. 1	11	0	6	0	17
2	195	19	56	0	270
3	170	15	42	0	227
4	111	8	5	0	124
5	124	19	20	0	163
6	651	57	173	0	881
7	9	0	0	0	9
8	81	41	69	0	191
10	68	12	35	0	115
11	17	0	0	0	17
12	9	0	0	0	9
15	29	5	0	0	34
16	38	9	0	0	47
Total	1736	224	580	10	2550
Per cent	68.0	8.8	22.8	.4	100

It was noted during the days from the first appearance of the plants

[1]Published by permisssion of Secretary of Agriculture.

above ground on September 10 to the period of injury by developing fly larvae that the root systems of the individual plants were steadily enlarging and that excessive tiller formation was becoming more pronounced. Rye in particular showed rapid tiller formation. Infestation counts were made November 25th after the plants had reached the maximum growing period with the advent of winter. An adaptation of the five linear foot method was used for selecting plants for examination. By this method samples are taken to include all plants from five linear feet of drill row, each foot taken separately and at random. Infestation data thus obtained are given in Table II.

TABLE II—INFESTATION DATA SEPT. 1, SOWING

Sowing	Plants		Culms		Larvae						Puparia Per culm		Total
					Size			Per culm					
	Examined	% Infested	Examined	% Infested	Small	Half grown	Mature	Max.	Aver.	Total	Max.	Aver.	
Wheat	50	96	135	44	4	0	85	9	2	89	26	5	274
Barley	50	64	210	20	3	3	16	2	2	22	4	1	46
Rye	50	6	410	0.7	0	0	1	1	1	1	3	2	4
Oats	50	0	62	0	0	0	0	0	0	0	0	0	0

A detailed chart showing the infestation data for each individual plant for the fall brood of flies is not possible on account of its large size. However, a summary showing the more important features is given in Table III.

TABLE III—SUMMARY OF DETAIL INFESTATION DATA

Plot	% Plants Infested by eggs	Eggs per Infested Plant			% Plants infested by larvae	Larvae per Infested Plant.		
		Max.	Min	Aver				Aver.
Wheat	100	118	4	35	96	26	1	8
Barley	74	17	1	6	64	7	1	2
Rye	90	44	1	13	6	3	1	2
Oats	8	4	1	3	0	0	0	0

II. Sowing September 14.

Plants of this sowing appeared above ground on September 20th. From this date and throughout the period of activity of the Hessian fly for the fall, ten plants were examined daily for each plot. Plants were selected at random and the accumulated egg masses recorded. Condensed results from the examinations are given in Table IV.

TABLE IV—ACCUMULATED EGG COUNTS

Date	Wheat	Barley	Rye	Oats	Total
Sept. 28	5	0	0	0	5
29	10	0	5	0	15
30	15	0	4	0	19
Oct. 1	29	7	25	0	61
2	31	9	18	0	58
3	51	12	16	0	79
4	110	19	17	0	146
5	157	26	12	0	195
6	161	20	18	0	199
7	139	10	28	3	180
8	198	8	39	6	251
9	170	50	41	0	261
10	232	29	37	1	299
11	126	15	11	0	152
12	104	12	58	0	174
13	284	23	34	0	341
14	159	48	51	0	258
15	77	18	29	0	124
16	129	24	3	0	156
17	45	24	0	0	69
18	16	6	0	0	22
19	6	2	0	0	8
Total	2254	362	446	10	3072
Per cent	73.4	11.8	14.5	.3	100

Infestation counts for this sowing were made November 4th before the plants had stooled excessively, though at this time the rye plants were sending out many succulent tillers. The results thus obtained are given in Table V.

TABLE V—INFESTATION DATA, SEPTEMBER 14 SOWING

Sowing	Plants		Culms		Larvae						Puparia		
					Size			per culm			Per culm		
	Examined	% Infested	Examined	% Infested	Small	Half grown	Mature	Max.	Aver.	Total	Max.	Aver.	Total
Wheat	100	98	100	98	58	154	317	18	5	329	9	2	33
Barley	100	62	100	62	60	34	16	6	2	110	2	1	4
Rye	100	8	100	8	6	4	5	4	2	15	0	0	0
Oats	100	0	100	0	0	0	0	0	0	0	0	0	0

SUMMARY

Observations from two series of plots made daily throughout the full emergence period of the Fall of 1921 at Centralia, Illinois show that adjacent and identical prepared plots of wheat, barley, rye and oats are subjected to fly attacks in varying degrees.

The order of selection for oviposition runs in descending order wheat, rye, barley and oats. From data in which daily egg counts were made from a numbered series of plants (Table 1) the total number of eggs being considered 100%, wheat received 68%, barley 8.8% rye 22.8% and

oats .4%. Likewise accumulated egg counts made from a constant number of plants (Table 4) show that wheat received 73.4%, barley 11.8%, rye 14.5% and oats .3%.

Resultant larval infestation from the fall oviposition of the Hessian fly on wheat, barley, rye, and oats was primarily manifest in wheat and barley. Rye, though second in selection for oviposition, was scantly infested and oats not at all. The percentages of plants infested from these two series of plots (Tables 2 and 5) were for wheat 96 and 98, for barley 64 and 62, and for rye 6 and 8 respectively.

INJURY TO BELL PEPPERS BY *BLAPSTINUS CORONADENSIS*[1] BLAISD. AND *B. DILATATUS*[1]

By ROY E. CAMPBELL, *Scientific Assistant,*
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During the first week of September, 1921, the writer's attention was called to some fields of young bell peppers near La Habra, Calif., which examination showed were being damaged by tenebrionid beetles feeding on the stems at the surface of the ground. It was evident that individual beetles did not do much feeding at one time, but because of their numbers around many plants and their continuous feeding, serious damage had resulted. This injury varied from a hole or two into the epidermis to the complete girdling of the stem for an inch or more. In severe cases, although the plant continued to grow for some time, it soon broke off because of the weakened stem. In other cases, when the process of feeding was slow, the wound healed over and the plant recovered. The more seriously infested part of the fields suffered a damage in killed plants of at least 25 per cent, but the average for the entire fields would not be over 5 per cent. Many more plants were injured, but were not killed.

The field most seriously damaged had been cultivated for 5 years. Opposite was a young lemon orchard separated by a dirt farm road which had not been plowed for several years. The greatest damage was to the rows near this old road. The soil was a rather heavy clay loam, the elevation about 500 feet, in the edge of a range of foothills. About half a mile away, near the top of a hill, 100 feet higher, was another field similarly but not so seriously damaged. Various counts indicated a maximum number of 75 beetles around the stem of a single

[1]Identifications by Dr. F. E. Blaisdell.

plant! It was not uncommon to find a dozen or more beetles, while the average in the parts of the field suffering damage was about 6 beetles to a plant.

Of the two species concerned in this infestation, *Blapstinus coronadensis* and *B. dilatatus*, the former was by far commoner.

A number of experiments were made with different materials which were placed on the ground around the stem of the plant. Among the materials used were ground tobacco, nicotine dust, nicotine dust and calcium arsenate, Bordeaux mixture (both wet and dry), Bordeaux mixture with nicotine dust, and hydrated lime. Some were merely applied to the top of the ground, while others were covered with soil after application. Later examinations showed that the wet sprays were valueless, but that dry dusty material had a decided deterrent effect. This was checked up by using hydrated lime on a larger scale, with results as follows:

Check Undusted	33 plants with beetles around stem; 2 plants with no beetles.
Dusted	6 plants with beetles around stem; 29 plants with no beetles (5 of these plants did not have lime thoroughly about stem)
Check Undusted	23 plants with beetles around stem; 13 plants with no beetles.

Field observations confirmed these results. If the lime were so applied as to cover the ground completely around the stem, the beetles ceased to feed.

For applying the lime, a bellows type of hand duster was used. With the feed wide open, a single puff of dust thoroughly covered the ground on one side of the stem. The operator proceeded up the row, giving a puff to each plant, and then came back on the same row, so as to cover the ground on the opposite side.

Very little feeding was observed after the lime was applied. A number of plants died, having been previously injured, so that the increased weight of the growing top caused them to break off.

The pepper fields were under irrigation, and the one most seriously damaged was level with a gentle slope to the South. To test the possibility of killing the beetles by flooding the field, a number were brought to the laboratory and placed on soil submerged in water. The beetles were very active for over an hour, when some became quiescent. These

were removed, and soon recovered. Others continued to move, although with less vigor, for three hours, and were then allowed to remain over night in the water. The next morning practically all of them were still alive, although they had been under water for 18 hours. This indicated that flooding fields infested by these beetles would be useless as a control measure.

Dr. F. H. Chittenden, Bureau of Entomology, informs the writer that on two occasions other species of Blapstinus have been destroyed by poisoned baits used by employees engaged in Truck Crop Insect Investigations. The first of these experiments was performed by Mr. H. M. Russell in the spring of 1911 in combating an outbreak of cutworms on sugar beet in southern California. Bran, shorts and Paris green were used in the preparation of this bait. It was applied May 1 and when the infested fields were examined later, in addition to an abundance of dead cutworms, many Blapstinus beetles were found lying dead beside the poisoned bait.

UTILIZATION OF SYSTEMATIC OBSERVATIONS ON BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER) AND CURLY LEAF OF SUGAR BEETS

By EDWARD A. SCHWING, B.S. and WILLIAM J. HARTUNG, B.S.
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Sugar companies demand information as to the number of beet leafhoppers (*Eutettix tenella* Baker) present during the spring invasion of the pest into the beet fields, and also at very frequent intervals, the extent and progress of curly leaf (curly top or blight) which this insect transmits. Reliable information must be at hand for economic reasons. The desultory manner of gathering and recording this information in the past, resulted in data of very little value to the sugar companies as a reference to the average number of leafhoppers for a certain number of beets and the possibility of securing a marketable crop. During 1920, the recording of information was put on a sound workable basis with all of the essential facts and related data. The following headings were found to be most satisfactory in tabulating the data:

Location	Date	Weather conditions	Size of beet	Curly leaf	Number hoppers per 100 ft. of beet row
Ranch 3 Doud Tract	May 4-21	8:30 a. m. sunshine, quite	6 leaves unthinned	20%	15 adults

In checking up the percentage of blight in a field, two rows of 50 beets were counted, and the average percentage of curly leaf was computed. Curly leaf was determined by examining the youngest or innermost leaf of a beet for the earliest visible symptom; namely, the transparent network of minute veins.

The determination of the number of beet leafhoppers to 100 feet of beet row is a difficult and tedious task. Trial after trial by sweeping with an insect-net proved that this method of ascertaining the number of insects in a beet field was inaccurate. The method which we employed was to disturb the foliage with the hand and carefully examine each beet and surrounding soil for leafhoppers, while the observer crawled along the row of beets on his hands and knees. Months of this experience makes one very adept and the possible error is reduced to a minimum. Time after time observers have checked the results of each other and the counts of the number of hoppers were so nearly the same, that it is felt that the data thus obtained is reliable.

In the Salinas Valley, where this work has been carried on systematically weather conditions are an important factor in ascertaining the number of insects. Early in the morning, when it is cool and still quiet, the adults in the beet fields are sluggish and easy to count. In the Salinas Valley a daily wind blows from about 10 A.M. until evening. When this wind prevails, the hoppers are difficult to find and the work for the day must cease if accurate results are to be recorded. During cloudy, cool mornings the determinations are very accurate; on warm, sunshiny mornings, the activity of the leafhopppers makes observation more difficult and less accurate.

During 1920, the number of adults in the beet fields of the Salinas Valley remained almost constant from the time that the invasion of the pest occurred in early May until the second brood adults made their appearance during the last week in June. Nymphs began to appear in early June and increased as the month progressed. The same condition with slight modifications was found to be true in the present season of 1921.

The size of the beet at the time that the leafhoppers appear in considerable numbers in the fields and the relative number of hoppers present have a direct bearing on the tonnage harvested. At King City three beet fields on which data was kept during 1920, showed the effect of the time of planting. One tract planted about April 1, was being thinned about the time that the spring brood adults flew into the beet fields during the early part of May. By June 26, these beets were all blighted,

and at the end of the season a crop of less than one ton per acre was harvested. Beets planted in January, 1921 in the same field averaged eight tons per acre. On a second tract planted about the last of March, 1920 the beets were still unthinned when the spring brood made its appearance. Blight made quick inroads on this area also, amounting to 100% by July 24. The yield from this field was 3.1 tons per acre which hardly paid for harvesting the crop. A third tract was planted in February. When the bugs appeared, these beets were making a thrifty growth and continued to grow but did not show the effect of curly leaf until much later in the season. These beets did not show 100% blight until August 20, and before that time they were ready to harvest. Even though a delay of the last irrigation due to power shortage reduced the crop, a yield of over seven tons per acre was secured from this field.

In the fog belt districts more leafhoppers were present and a higher percentage of curly leaf occurred in early planted beet fields than in fields planted after the invasion of the pest had occurred in the Salinas Valley. March plantings showed 80% curly leaf on July 23, near Chualar, while beet seeds which germinated after May 1, showed only 3% blight on August 5. At Santa Rita 60% of the early planted beets were blighted compared with 3% in an area replanted on account of the disease in the same field. The same condition occurred in the San Juan Valley; where, on one side of the river, March and April plantings were destroyed by curly leaf, while on the opposite side of the river late plantings produced a good crop.

The two following questions are frequently asked by growers: (1) Can a profitable crop of sugar beets be grown where the beet leafhopper is present? (2) Will it pay to allow beet fields that are attacked by leafhoppers to complete their growth, or is it advisable to plow up the beets and plant some other crop? Systematic observations show that under semi-arid conditions near King City, Salinas Valley, beets planted before March 1, with proper cultural methods and soil moisture, will produce a fair yield in blight years. If beets have not been thinned or have just been thinned, when the adults invade the fields, the possibility of a crop is very problematical; in fact, a failure is almost a certainty when one leafhopper to 20 beets are present. If the beets have been thinned and possess not over 16 leaves, with the same number of insects, the crop is still doubtful and the beets may or may not pay for harvesting. In the case like the latter, beets had best be left to complete their growth if there is doubt as to the success of a crop planted at this time. In the fog belt districts of the Salinas Valley where climatic conditions

are favorable, replanting may be resorted to when the first planting becomes badly blighted in the early part of the season.

Systematic records of this nature should be continued in years when the beet leafhoppers are at their maximum in number, and through the interval between outbreaks so that all conditions can be recorded. Better decisions on crop prospects with reference to curly leaf and the number of beet leafhoppers can be rendered early in the season with more data available.

THE EFFECT OF ACTIVITY ON THE LENGTH OF LIFE OF HONEYBEES

By E. F. PHILLIPS, *Bureau of Entomology*

That honeybees live longer when they are least active has been known for many years. This is especially evident from the fact that during the heavy honey-flow the worker bees live about six weeks while during the winter they may live four times as long. It may be that this difference is in some degree associated with certain physiological conditions which need not be discussed at this time, but it seems clear that the chief difference is in the amount of work which they are called upon to do. It has for a number of years been believed that the greater the activity of the bees, the shorter their term of life.

In connection with some experiments to determine the availability of various carbohydrates as food for worker bees, it was noted that the bees used as checks on the experiments, and which were given no food whatever, lived for different periods, taking an average of the daily death rate. In the first series of experiments (August 1914) the bees without food averaged 1.74 ± 0.0377 days. In the second series (September 1914) the average for unfed bees was 4.34 ± 0.0662 days. For the third series (September 1919) the average was 1.375 days. For the fourth series (May 1922) three lots of bees without food were put under different conditions, and it is the purpose of this note to discuss these results in detail. In a fifth series (May 1922) the average for the bees without food was 2.4164 ± 0.0216 days.

In the fourth series three lots of worker bees were placed in wire-cloth and wood cages and each cage was provided with a water bottle but the bees were given no food after the beginning of the experiment. The small number of drones in each cage is omitted from the following figures:—Lot No. 1 (274 bees) was placed in a dark room in the basement of the laboratory, light being introduced into the room once daily when the

dead bees were removed for counting. Lot No. 2 (294 bees) was placed in a room of the laboratory within one foot of a 40 watt Mazda light which burned night and day until all the bees were dead. This caused excessive activity as long as the bees were capable of it. Lot No. 3 (248 bees) was kept in a room of the laboratory without artificial light and where the direct sunlight did not strike the bees at any time. The light was not strong as the exposure of the room is to the north and east and the window on the east side is partly shaded by a tree. The bees in this lot were quite noisy with periods of rest.

The worker bees in the dark room lived an average of 2.1934 ± 0.0286 days. The temperature in this room varied between 18.8° and 20.4° C. during the life of these bees. The last bee died on the fourth day. The bees of Lot 2 under constant light lived an average of 1.1293 ± 0.0194 days, the last bee dying 42 hours after the installation of the bees. The average temperature as recorded by a thermometer lying beside the cage varied between 23.1° and 27.2° C. The bees kept in diffused light in the laboratory lived an average of 1.2261 ± 0.0291 days, the last bee dying 51 hours after the beginning of the experiment. The temperature in this room varied between 22° and 24° C.

These bees were installed at 1:30 P.M. on May 10. At 6:30 P.M. on the next day one drone in the lot under constant light was still able to walk and two worker bees were moving their antennae. At 8:30 P.M. on the 11th one of the workers moved slightly. At 8:00 A.M. the next morning all were dead. In the lot kept in diffuse light during the day five workers were seen moving feebly on the morning of the second day and they were all dead at 4:00 P.M. Those in the dark room became sluggish also but not so rapidly. The death rate by days is recorded in the accompanying table:—

TABLE SHOWING DEATH RATE OF WORKER BEES WITHOUT FOOD

Day	Dark Room		Constant Light		Diffuse Light	
	Dead	Temp. C	Dead	Temp. C.	Dead	Temp. C
1	42	20.4	256	27.2	182	24.0
2	141	19.8	38	24.0	66	22.0
3	87	18.8				
4	4	18,8				
Totals	274		294		248	

That any animal will starve to death in so short a time as is here indicated is startling. That they died of starvation is obvious from the fact that in all the series recorded there were other lots of bees which were given various sugars as food on which the term of life was decidedly

increased. These data were obtained for another purpose and need not be given here in detail, but it may be stated that in the dark room at the same time that the bees without food were in it, a cage of bees containing 192 worker bees lived an average of 6.6719 ± 0.2089 days on cane sugar (sucrose C.P.). There were no cages of bees with food in connection with the other two lots without food recorded.

To determine whether the starved bees had completely utilized their food reserves, a few of the starved bees were examined. Some of the results are given herewith. One bee which had died in the dark room without food showed pollen grains in the rectal ampulla which were mostly empty. Stained with Sudan III, many of the apparently empty pollen grains showed small fat globules and there were innumerable small fat globules, as shown by this stain, still remaining free in the contents of this organ. The ventriculus was black in color and was filled with a disorganized mass of material with some pollen grains, both full and empty. Here also fat globules were seen in the full, partly empty and apparently empty pollen grains, but they were less numerous than in the rectal ampulla. Since it has not been fully established whether worker bees are able to digest fat, it may be that this food material is not available to them.

After the removal of the alimentary canal, the fat tissue lying dorsal to the wax-glands was scraped up and stained with Sudan III. These cells were full of fat globules, in some cases so full as to distort the cells. It would appear that the bees did not draw fully on this food reserve during the time that they still lived. That bees are able to utilize the fat stored in the fat body is scarcely to be doubted, in view of the occurrences during metamorphosis and larval life. In another bee which was examined in the same manner the same things were seen. In addition the fat body was stained with iodine but no trace of glycogen could be distinguished. It would appear that starvation had occurred while there was still some available food reserve in these bees, possibly occurring too rapidly to permit the bees to draw on this material.

Bees that had died in the cage under constant light were also examined and showed no glygogen in the ventral fat cells but did show fat in the ventriculus, in the rectal ampulla and in the ventral fat cells. None of the bees kept in the laboratory in diffuse light were examined in this way. In a private communication, Mr. R. E. Snodgrass states that he has observed fat bodies of starved caterpillars (species not recorded) in which the fat body is reduced in size but the remaining cells show a normal amount of fat, apparently as much as they can hold.

It therefore appears that rapidity of death by starvation occurs in direct proportion to the work the bees are called upon to do, and that when death from starvation occurs rapidly there is still a food reserve which has not been depleted. The relation between the work done and the death rate is quite in keeping with what has been so frequently observed for normal bees, namely that the normal term of life (barring accidents) is determined by the amount of work which the individual is called upon to do. Since bees in cages are not under normal conditions, they probably do more work than bees under ordinary hive conditions, as indicated by the fact that those on satisfactory foods do not live as long as bees are known to live in the hive. The longest period of life in these cages that has come to the writer's attention were some that lived for thirty days in a cool laboratory room. In the series here recorded, the last bee on sucrose died on the seventeenth day.

DUSTING VERSUS SPRAYING FOR THE CODLING MOTH IN WALNUTS

By H. J. QUAYLE

During the past three years a considerable acreage of English walnuts in Southern California has been dusted for the codling moth. During the first year standard or acid arsenate of lead was used but which was later abandoned because of the injury to the walnut foliage. Only basic or neutral arsenate of lead can be used with safety on English walnuts at least in the coastal sections of Southern California. In connection with the writer's investigation of the codling moth in walnuts, spraying was compared with dusting as a means of control. For this purpose four different orchards have been utilized where plots were sprayed and dusted at different times, and plots left as checks, during the past three seasons. A tabular summary of the results of dusting and spraying on two of these tracts for one season, which are representative, is given below:

	Orchard A	*Orchard D*
Reduction in wormy nuts by one spraying	5%	18.3%
" " " " " " dusting	3.1%	11.5%
	6.1%	22.0%
Infestation of check plot	157 lbs.	60lbs.
Average production per tree	7.85 "	11 "
Increase in sound nuts per tree by one spraying	4.86 "	6.9"
" " " " " " " dusting	$1.96	$2.75
Value of spraying per tree, nuts at 25c	$1.21	$1.72
Value of dusting per tree, nuts at 25c	.74	.45
Cost of spraying per tree		

	Orchard A	*Orchard D*
Cost of dusting per tree	.75	.44
Amount of dust per tree	10 lbs	6 lbs.
Amount of spray per tree	33 gals.	20 gals.
Net returns from one spraying per tree	$1.22	$2.30
" " " " dusting " "	.46	1.28
" " " " spraying " acre	18.30	46.00
" " " " dusting " "	6.90	25.60
Net difference per acre in favor of spray	11.40	20.40

TWO INJURIOUS FRUIT MITES IN PENNSYLVANIA

By S. W. FROST, *Ent. Research Laboratory, State College, Pa.*

Two mites have been found injurious on fruit trees in Pennsylvania. One is the European Plum Mite, *Paratetranychus pilosus* Can. & Fran., which was previously recorded in the JOURNAL[1] as a pest chiefly on apple and plum although it occurred to some extent on cherry and peach. A second mite, *Phyllocoptes cornutus* Banks has recently been found very abundant in parts of the state on peach. This species was first noticed in Cumberland county, Pennsylvania, in 1921, by Mr. W. A. McCubbin, Deputy Director State Bureau of Plant Industry, Harrisburg, and was thought at first to be a silver leaf resembling closely the European silver-leaf disease. Further examination and a consultation with an entomologist has identified the injury with that of a small mite which Mr. Nathan Banks has previously described and recorded from this country. It has also been found in Lebanon, Dauphin, and Adams counties and further examination will no doubt reveal its presence in other parts of the state.

Both species produce characteristic injury upon their hosts. The European Plum Mite causes the leaves to turn yellowish and later become bronzy in color. The silver Leaf-mite of peach causes the leaves to become silvery and later become leaden in color. Both species have a tendency to flatten the leaves so that the appearance from a distance is very different from the normal foliage.

Scientific Notes

Aroostook Potato Insects[2]. Since aphids have been found to transfer potato mosaic and leaf roll (Bulletins 292, 297, and 303 Me. Agr. Exp. Sta.), and certain other insects with piercing and sucking mouthparts are being viewed with suspicion,

[1]Journ. Econ. Entomology, Vol. 12, pp. 407-408, 1919.

[2]Papers from the Maine Agricultural Experiment Station: Entomology No. 111.

PLATE 6

Silver leaf of peach

Normal peach leaf

Normal apple leaf

Red spider on apple

a list of Hemiptera frequenting potato vines may prove suggestive to persons interested in experimental work with disease transference. The following insects were collected from potato at Presque Isle, Aroostook County, Maine in 1921 by the writer and field assistant, and were determined by Dr. Herbert Osborn. While certain of them may have been resting on potato vines by chance, most of them were common enough to be taken repeatedly though none, except *Lygus pratensis*, were abundant enough the past season, to assume significant economic importance. It will be noticed that *Empoasca mali* is conspicuous by its absence[1]. *Cosmopepla carnifex*, July 15; *Canthophorus cinctus*, July 15; *Adelphocoris rapidus*, July 15-25; *Poecilocapsus lineatus*, July 15; *Lygus pratensis*, July 15-Sept. 8; *Philaenus spumarius*, July 15-Aug. 20; *Philaenus lineatus*, July 15; *Clastoptera proteus*, July 15; *Ceresa basalis*, July 25-Aug. 20; *Platymetopius acutus*, July 15; *Acocephalus nervosus (striatus)*, July 15-Sept. 8; *Phlepsius apertus*, July 31; *Graphocephala coccinea*, Aug. 6; *Agallia sanguinolenta*, July 31.

The following predaceous damsel-bugs were present: *Nabis roseipennis*, Aug. 25.-Sept. 8; *Nabis ferus*, July 15-Sept. 8; *Nabis limbatus*, July 15; *Nabis subcoleoptratus*, July 31; *Pagasa fusca*, July 31.

Euschistus tristigma, Sept. 11; and *Pentatoma juniperina*, July 11, were found feeding on potato vines at Caribou, Aroostook Co. in 1906 (Bulletin 134, Me. Agr. Exp. Sta.).

EDITH M. PATCH

Mexican Bean Beetle: We have just received what appears to be the first official record of the Mexican Bean Beetle, (*Epilachna corrupta* Mull.) in the state of Utah in some material sent in for determination. This material was collected at Rockville, Utah, July 5, 1922, by V. M. Tanner, St. George, Utah. Incidentally, this may also be the most westerly infestation of this insect yet reported.

GEORGE M. LIST
Colorado Agricultural College, Fort Collins, Colo.

The Value of Carbon Bisulphide in Combating Tent Caterpillars and Mosquitoes. In the use of fire torches for the destruction of tent caterpillars, often a considerable number of smaller twigs and limbs are damaged or killed by the heat, and ground fires may be started from the droppings from the torch.

Carbon bisulphide seems to be very effective in killing these pests and may be used as follows: Take a long pole with a blunt point at the end, place on this point a piece of raw cotton well saturated with carbon bisulphide. This should be pushed into the web and, by turning the pole, be left inside where the fumes will almost immediately kill all the occupants.

In the control of mosquitoes, gasoline is objectionable on account of it making the water unfit for many purposes. Last June the water in a ten-gallon tub was found to be swarming with the larvae of mosquitoes. A few drops of carbon bisulphide was poured into the receptacle and it sank to the bottom, resembling pearl-like bodies. Within a few minutes there was undue agitation among the insects and at the end of a half hour all were dead and floating on the surface of the water. The carbon bisulphide did not give the slightest taste or smell to the water.

A. K. FISHER, *U. S. Biological Survey*

[1]Reported as "fairly common" in beans at Houlton (Bul. 236 Me. Agr. Exp. Sta.)

Sticky Bands in France: In No. 27 of the current volume of the "Comptes Rendus des Séances de l'Académie d'Agriculture de France," M. Paillot, Director of the Southeast Entomological Station of France, presents an interesting paper on the sticky bands which are being used against the *Cheimatobia*. He experimented in former years successfully with American tanglefoot, but on account of the expense of the latter, he has recently been experimenting. He finds that the mixture prepared by Collins and Hood of the Gipsy Moth laboratory at Melrose Highlands is very effective, preserving its sticky quality for a very long time, and at the same time is much cheaper than the tanglefoot. He endeavored to have the same mixture prepared by a firm in Lyon, but without perfect success, the mixture drying too rapidly in the open air. He hopes to be able to prepare a mixture comparable to the Collins and Hood mixture, as described in Bulletin 899 of the Bureau of Entomology, since the substances of which it is composed are readily obtainable in France. He proposes to use it, not only against the *Cheimatobia*, but against the gipsy moth whenever outbreaks of the latter species occur in France.

L. O. H.

Outbreak of the Birch Skeletonizer: The birch skeletonizer, *Bucculatrix canadensisella* Chambers, is abundant in Connecticut this season and acres of *Betula populifolia* in New Haven County were brown in September. Other species of birch are attacked, but not skeletonized or injured to the same extent. W. E. B.

Spread of Gipsy Moth in Connecticut: Last winter's scouting revealed an extensive spread of the gipsy moth in Connecticut, apparently due to wind-spread in the spring of 1921 and in some cases old egg-masses were found showing that the wind-spread occurred in 1920. Most of the infestations are small and scattered, but it is now necessary to spread our control work over more than three times the area covered heretofore, which will be difficult without a larger appropriation. Windham, Tolland and Hartford Counties are now generally infested, all of New London County except two towns in the southwest corner, the northern part of Middlesex County, northern part of Litchfield County along the Massachusetts border to the New York State line, and two towns in the northern part of New Haven County are scatteringly infested. Fairfield County has not yet been found infested. Of the 169 towns in the State, 95 are now covered by State and Federal quarantine instead of 26 a year ago. W. E. B.

Apple and Thorn Skeletonizer: The apple and thorn skeletonizer, *Hemerophila pariana* Clerck, was first found in Greenwich and Stamford, Connecticut, late in the fall of 1920, having been discovered in Westchester County, N. Y., two or three years prior to that date, where it had evidently been introduced in some way from Europe. On June 24, 1921, many unsprayed apple trees in Greenwich and Stamford, Conn., were brown and adults were found resting on the leaves and on daisies in the fields. Before the season ended, this insect was received at my office from many points in Connecticut and was observed at other places by members of the department staff, showing that it had already become distributed nearly all over the State. This pest has attracted a good deal of attention during the present season, and now (September 15) unsprayed apple orchards in New Haven County and the southern part of Hartford County look as if a fire had gone through them. On the other hand, the attack of this insect has been less severe in Greenwich and Stamford than in 1921. The injury to sprayed orchards is slight. W. E. B.

European Corn Borer Conference: On September 7th and 8th a party of forty-three officials, county agents and farmers from the state of Ohio visited the European Corn Borer Laboratory at Port Stanley, Ont. They arrived at Port Stanley from Cleveland on the afternoon of the seventh, coming across Lake Erie on the Ohio Fish and Game Commission's boat.

The morning of the eighth was spent in visiting the laboratory and then a trip was made in motor trucks to some of the more heavily infested fields. Stops were also made at the Dominion Government experimental control plots and at different fields where corn had been planted in accordance with suggestions made by the officers of the Entomological Branch. It was readily seen that late planted corn suffered less injury from the European corn borer as compared with that planted earlier in the season.

The object of the trip, which was organized by the Ohio Department of Agriculture, was to bring to the attention of the farmers and county agents of that state the necessity of cooperative action in sections where the European corn borer is present and doing extensive damage. The visitors returned to Cleveland by boat on the afternoon of the eighth.

The party was in charge of Mr. L. J. Taber, Director of Agriculture for Ohio, and included E. C. Cotton, Director of Plant Industry, Columbus; Prof. Raymond C. Osburn, Ohio University; Prof. Herbert Osburn, Ohio University; H. A. Gossard, State Entomologist; J. S. Houser, Assistant State Entomologist; T. H. Parks, Extension Entomologist, and N. E. Shaw, Columbus. Mr. W. A. Walton, Chief of the Division of Forage Insects, and Mr. L. H. Worthley, in charge of Corn Borer Control, of the United States Department of Agriculture accompanied the visitors.

Mr. L. S. McLaine, Chief of the Division of Foreign Pests Suppression and Messrs. Crawford and Keenan of the Entomological Branch and Capt. G. J. Spencer of the Ontario Department of Agriculture, conducted the party through the infested area.

THIRTY-FIFTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The 35th annual meeting of the American Association of Economic Entomologists will be held at Boston, Mass., December 28 to 30, 1922.

The day sessions will be held at the Massachusetts Institute of Technology, Cambridge, and at least one evening session will be held in the Auditorium of the Boston Society of Natural History.

Hotel headquarters will be at the Brunswick, Boylston Street, near Copley Square. As hotels are likely to be crowded during the Christmas holidays, members are urged to secure reservations by corresponding direct with the hotel at once.

During convocation week, it is planned to hold a joint meeting with the American Phytopathological Society. Members interested in medical entomology will hold a joint session with Section N, and the entomologists especially interested in extension work and in the Insect Pest Survey plan will hold special group meetings.

Applications for membership should be filed with the Secretary as early as possible, and should be accompanied with the fee of $3.50. Application blanks can be secured from the Secretary or the chairman of the membership committee.

A. F. BURGESS, Secretary
Melrose Highlands, Mass.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1922

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, provided that at least 100 reprints be ordered at full price rates; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

Separates or reprints, if ordered, when the manuscript is forwarded or the proof returned, will be supplied to authors at the rates given below. Note that the number of pages in a reprint may be affected somewhat by the make-up, and that part of a page is charged as a full page. Carriage charges extra in all cases. Shipment by parcel post, express or freight as directed.

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The control of the mosquito nuisance in our most important National Parks which are visited by tens or hundreds of thousands of people each year will appeal to most tourists and to many others who remain at home. When the writer visited the Yellowstone National Park fifteen years ago this summer, mosquitoes were rather annoying around some of the permanent camps, and when asked to speak at one of the open fireside gatherings in the evening at one of these camps, he explained the biology and habits of mosquitoes and predicted the future control of this nuisance by Governmental agencies. As these species are local, it would not be so difficult a problem as it may seem to the uninitiated, to do away with most of the nuisance around the permanent camps and hotels and around the areas where public camping is permitted. Possiby some system of control is already in force, but if so the writer has not heard of it. It is gratifying to learn that the Canadian Government has already undertaken to control the mosquito pest in Rocky Mountain National Park as will be seen by another note in this issue. It is also gratifying to learn that these efforts are already bearing fruit, and that the spring work has greatly reduced the numbers of adult mosquitoes. A temporary laboratory has been established at Banff, and the Entomological Branch and the Park officials are working in close co-operation.

Our National Parks are considered a national asset. Some of them are not visited by tourists and may well be left in their natural condition. Other parks are maintained for tourists and in them the health and comfort of the visitors should be safeguarded. It is hoped that mosquito control may soon be inaugurated in other National Parks both in Canada and in the United States.

W. E. B.

It seems a far cry from roses to potatoes. Few would think of utilizing aphids for the location of roses. Only a specialist would dare to hold that a biological relationship existed between roses, potatoes and aphids and that the last named in turn may have an important part in the dissemination of a plant disease. Few specialists expect their studies to result in immediate or practical applications, though there is no question as to the basic utility of such investigations. Specialization in agriculture has brought about conditions here and there in the country where scientific knowledge is of great practical value. Those interested in an admirably presented story of investigation and accomplishment, should read the epic of the rose and the potato entitled: "Marooned in a Potato Field," which appeared in the August issue of the *Scientific Monthly*. This recounts the history of one of the many justifications of scientific work and is another striking instance of the need of effective co-operation among investigators in different branches of science.

Current Notes

Mr. W. L. Distant, a prominent Hemipterist, died at Wanstead, England, February 4, 1922, at the age of 77 years.

Mr. Ed. L. Ayers, formerly nursery inspector in Texas, has been appointed extension entomologist and pathologist of Florida.

Messrs. R. W. Morcland, J. W. Couch and Rowland Cowart of the Bureau of Entomology laboratory force at Mound, La., have recently resigned.

Dr. Carl J. Drake, formerly of Syracuse University, has been appointed State Entomologist of Iowa, and has already entered upon his duties.

Mr. A. F. Burgess, in company with Professor J. S. Houser, visited Cleveland, Ohio, on July 31, to examine the areas recently dusted by aeroplane.

Mr. Leland H. Taylor, graduate of the Massachusetts Agricultural College and of the Bussey Institution, has accepted a position as Instructor of Zoology, West Virginia University.

Mr. Theodore E. Frison, of the Japanese Beetle Laboratory, Riverton, New Jersey, has been appointed Assistant in the Department of Entomology of the University of Illinois.

Dr. Guy C. Crampton of the Department of Entomology at the Massachusetts Agricultural College, visited the field station of the Bureau of Entomology at Wallingford, Connecticut, July 7 and 8.

Severe outbreaks of the forest tent caterpillar are reported from New Brunswick and Manitoba, while from Quebec and Ontario the apple tent caterpillar is said to be very abundant this year.

Professor F. Silvestri, one of the foreign members of the American Association of Economic Entomologists, has just been made foreign correspondent in the Section of Agriculture and Natural History of the Academy of Agriculture of France.

Mr. Stanley W. Bromley, Massachusetts Agricultural College 1922, has been employed during the summer as assistant at the Wallingford, Conn., field station of the Bureau of Entomology. He will return to the Massachusetts Agricultural College this fall to take up graduate work in entomology.

Mr. G. E. Sanders, formerly of the Dominion Entomological Laboratory at Annapolis Royal, Nova Scotia, and later with the Dosch Chemical Co., Louisville, Ky., is now manager of the Deloro Chemical Company, Ltd., Deloro, Ontario, Canada.

According to *Science*, Dr. W. J. Holland, since 1898 director of the Carnegie Museum, Pittsburgh, has become director emeritus, and is succeeded by Mr. Douglas Stewart.

According to *Science*, Dr. W. H. Brittain, provincial entomologist of Nova Scotia, has been appointed a member of the council of the American Association for the Advancement of Science, to represent the Canadian Society of Technical Agriculturists.

According to *Science*, Mr. William Schaus of the U. S. National Museum, has been elected an honorary member of the Entomological Society of Brazil in recognition of his extensive work on the butterflies and moths of Brazil.

Mr. O. I. Snapp, Bureau of Entomology, was scheduled to attend the 46th annual meeting of the Georgia State Horticultural Society, September 6 and 7, at Cordele, Ga., and to discuss the plum curculio investigations being carried on by the Bureau.

Messrs. C. C. McDonnell, Chief, and Ira N. Neifert and W. H. Tonkin of the Federal Insecticide and Fungicide Laboratory, have been conducting field experiments in Maryland with different gases to control the insect pests that infest grains in storage and in transit.

Dr. L. O. Howard was scheduled to speak on "Warfare Against Insects" in a course of lectures on science to be given daily from July 10 to August 15 at the Horace Mann Auditorium, Teachers College, Columbia University, New York City. The lectures are given at 2:30 P. M.

A study of the natural control of the tent caterpillar of which there is a serious outbreak in the maritime provinces this year is marked by a conspicuous absence of parasites. In 1915 this insect was almost entirely killed out by a light frost and the parasites may have been killed out at the same time.

Mr. E. J. Newcomer reports that the efforts of the Bureau of Entomology in importing codling moth parasites from the East for establishment in orchards around Yakima, Wash., under way for the past two or three years, have been successful, in the case of one species at least, *Bassus carpocapsae*, which has been secured from band material collected last fall.

The scouting to determine the spread of the apple sucker in Nova Scotia was completed some time ago. As a result of this work it was found that the pest had spread into quite a large area, particularly in a southerly and southwesterly direction. The work was carried on in co-operation with the Nova Scotia Department of Agriculture.

The European corn borer scouting work was started in Canada on July 24th, but all the crews were not at work until August 1st. Five crews are now engaged in the scouting and up to August 5th, twenty-four townships were scouted, eleven of which were found infested. A total of 412 fields were examined, comprising about 1929 acres of corn.

Mr. J. C. M. Gardner is a Carnegie student and not a Rhodes Research Scholar as was stated in the August issue of this JOURNAL. Besides visiting Canada he spent six months in the United States and traveled from Washington to the Pacific Coast and back again, visiting field stations. He also investigated the gipsy moth and European corn borer work near Boston, and sailed for England on August 22.

During the latter part of August and the early part of September, Dr. A. C. Baker of the Bureau of Entomology made a trip through the northeastern part of the United States, observing insect conditions in the grape belt in western New York State and Ohio, and visiting the Bureau field stations at Sandusky, Ohio and Wallingford, Conn., and the Connecticut Agricultural Experiment Station.

Professor H. A. Ballou, Entomologist to the Imperial Department of Agriculture, located at Barbados, British West Indies, will move his office to the West Indian Agricultural College, St. Augustine, Trinidad. This has resulted from the amalgamation of the department of Agriculture and the Agricultural College. Professor Ballou will have charge of the entomological work in the College and the experimental work in the West Indian Islands, as heretofore.

Mr. W. R. Walton, Bureau of Entomology, in company with Mr. Arthur Gibson, Dominion Entomologist, and Doctors Craighead and Tothill, reached Fredericton on July 20, and proceeded to the head waters of the Cains River. On the 21st, they traveled by canoe to the mouth of the river where it unites with the Miramichi, a distance of about 70 miles, and saw much injury caused by the spruce bud worm.

Mr. L. S. McLaine, Chief of the Division of Foreign Pests Suppression, Canada, returned from the west on July 14th. During his journey eastwards he met and discussed with the various Provincial officials the proposed changes to the regulations under the Destructive Insect and Pest Act, and also visited the fumigation stations at North Portal, Sask., and Winnipeg, Man. Mr. McLaine left for a short visit to southern Ontario the latter part of July and returned on August 3d.

Arrangements have been made with the management of the *Dallas News* and *Dallas Journal* to broadcast from their radio station talks by F. C. Bishop of the Bureau of Entomology on insects and their control. It is planned to make these talks timely and presented in simple form so that they can be understood and utilized by all classes of people. There is a lively interest in the radio throughout north Texas, and this is especially apparent in the rural communities. It is believed that these talks will aid the farmers in combating insects which threaten their crops and also help disseminate information on those forms inimical to domestic animals and poultry. Considerable attention will be paid to disease bearing insects and household pests. The first talk of the series was broadcasted on September 5th, and it is planned to give out regularly two talks each week. The first was of an introductory nature entitled "Insects and Human Welfare." Some of those following deal with the cotton leaf worm, mosquitoes, the bollworm, the screw-worm, Argentine ant, and ox warble.

Dr. A. E. Cameron, professor of zoology in the University of Saskatchewan, has now definitely severed his connection with the Entomological Branch, Canada. Dr. Cameron became associated with the Branch in 1917 on the invitation of the late Dr. C. Gordon Hewitt, whom he followed as lecturer in economic zoology in Victoria University, Manchester, England. Dr. Cameron has continued to carry on the work of the Branch in Saskatchewan since his resignation in 1920 pending the appointment of a qualified entomologist.

The termite, *Coptotermes niger* Snyder, is causing serious damage to lead-covered cable at the locks of the Panama Canal. These termites work through the lead, often causing large openings, and then travel between the two wires of the Duplex cable. Since the space between these two wires is not ample, they eat away the insulation. Another termite, *Nasutitermes ephratae* Holmgren, is a very serious offender also; it does not care for lead but works havoc in rubber, cloth, and other insulation.

The following appointments in the Bureau of Entomology have been announced. Mr. Chester I. Bliss of Columbia University, field assistant grape insect work, Sandusky, Ohio; temporary appointments, L. P. O'Dowd, sugar cane insect investigations, southern Mississippi; E. F. Haden; H. C. Plummer, M. L. MacQueen, T. P. Weakley, W. B. Weakley, L. N. Judah, tobacco insects, Clarksville, Tenn.; Dr. Carroll G. Bull, W. C. Gideon, J. A. Welch, malaria mosquito work, Mound, La.; A. J. Chapman, Alex Clark, J. R. Cole, R. C. Dancy, S. B. Hendricks, R. L. Hester, E. E. Holley, J. E. Humphries, J. W. Ingram, I. T. Jones, W. H. May, A. L. Monroe, Wm. D. Reed, Paul D. Sanders, J. T. Wilson, T. L. Wilkerson, L. P. Hodges, H. C. Young, cotton boll weevil work, Tallulah, La.

The scouting work for the alfalfa weevil was started in southern Alberta on July 1st. Owing to the large amount of alfalfa being grown in this area it was decided to determine whether this pest had invaded the alfalfa growing districts. The work is being carried on by Messrs. C. W. Minue and J. Lowe, and is under the immediate supervision of Mr. H. L. Seamans of the Lethbridge Laboratory. Up to July 31st, 286 farms had been visited and 6700 acres of alfalfa were examined; 313 collections of insects were made in the fields and upon examination at the Lethbridge Laboratory, no sign of the alfalfa weevil was found.

One of the best peach crops ever produced in Georgia was harvested in 1922. The progress made in overcoming the heavy curculio infestation has been very gratifying. All varieties through to the close of the Elbertas have been unusually free from curculio larvae. Careful investigations of commercial orchards treated according to the advice of Department and State specialists showed that curculio damage was not greater than an average of one wormy peach in each $\frac{5}{8}$-bushel basket. In these orchards dropped fruit had been picked up and destroyed and cultivation for the destruction of pupae had been practiced in addition to very thorough spraying. The San Jose scale appears to be on the increase in the Georgia peach belt.

Mr. J. E. Graf, entomologist in charge, field control, Mexican bean beetle, Bureau of Entomology, has just returned to Birmingham, Ala., after investigating the bean beetle in the Estancia Valley of New Mexico. He reports that the beetle has received a serious check owing to the shortage of moisture during the past winter and spring, which has occasioned a reduction in acreage from 90,000 to 20,000 acres

in the Valley. Distribution after hibernation follows prevailing winds down the canyon, but owing to the scarcity of food plants, beetles are becoming more widely separated than usual. Flights of one to two miles, several of which occur a day, are not uncommon. Since the average net return from an acre of beans is about $15.00, expensive control measures cannot be instituted.

Dr. J. M. Swaine, Chief of the Division of Forest Insects, Entomological Branch, Canandian Department of Agriculture, returned to Ottawa on August 2d, after spending some time in eastern Quebec and New Brunswick. Dr. Swaine reports an interesting situation in connection with the outbreak of the eastern spruce bark beetles of the Gaspé Peninsula. A considerable amount of the infested area was burnt over and some of the timber killed by fire in July, 1921. On this burn, all the large spruce which were scorched only at the base, are now attacked by the above insects, and this dying timber is drawing the infestation from the living timber for a long distance around the burned area. These trees are serving as traps and will be cut this coming winter.

Mr. Arthur Gibson, Dominion Entomologist, spent most of the week ending June 18th in western Ontario in connection with official matters. During this period the European Corn Borer Laboratory at Port Stanley, Ont., the Field Crop Insect Laboratory at Strathroy, Ont., and the Fruit Insect Laboratory at Vineland, Ont., were visited. On June 26 to 28, he attended the second annual convention of the Canadian Society of Technical Agriculturists held at Macdonald College, Que., having been elected a member of the Dominion Executive. Mr. Gibson was recently honoured by being elected an Honorary Member of the Quebec Society for the Protection of Plants. Mr. Gibson left Ottawa on July 16th for the maritime provinces, during his visit to the east he will investigate the work being carried on by various officers of the Branch in New Brunswick and Nova Scotia.

Mr. K. M. King, B.Sc., of Charlottesville, Va., was recently appointed Entomologist for Saskatchewan with headquarters at Saskatoon. The position in Saskatchewan has been vacant since the resignation of Dr. A. R. Cameron in 1920, owing to the fact that it has been impossible up to the present time to find a suitably trained man for the position. Mr. King received his training at the University of Washington and the Montana State College, and received his degree from the latter institution in 1920. Mr. King has had experience with grasshopppers and the pale western cutworm in Montana, which fits him particularly for his future work in Saskatchewan. Since April 1920, he has been engaged with the Bureau of Entomology working on insects affecting field crops. Mr. King served with the United States Army in France. He will report for duty in Saskatoon about the middle of August.

The following men have accepted temporary appointments at the Japanese Beetle Laboratory, Riverton, N. J., for this summer and have reported for duty: Prof. W. A. Price, of Purdue University; Dr. Henry Fox, of Mercer University; H. H. Pratt, a graduate of Rutgers College, and J. H. Painter, a graduate of the University of Maryland. There was received at the Japanese Beetle Laboratory earlier in the spring what is believed to have been one of the largest shipments of imported parasite material ever brought into this country from abroad. Something over a hundred thousand cocoons of a tachinid known to be parasitic on the Japanese beetle in Japan were sent to the laboratory by C. P. Clausen and J. L. King, who are stationed

in Japan and working upon Japanese beetle parasites there. A fairly large proportion of these cocoons were apparently in good condition upon their arrival at the laboratory and emergence has just commenced.

The Japanese beetle has been much more abundant during the present season than in any previous year and over a wider area. Serious damage has been caused by the immense numbers of the beetles to the foliage of many trees, especially fruit trees and certain varieties of shade trees. There has been important injury to early fruit, particularly early apples and early peaches. Recent visitors at the Japanese Beetle Laboratory, Riverton, N. J., include: Dr. E. D. Ball, Dr. L. O. Howard, Dr. A. L. Quaintance, and Dr. C. L. Marlatt from the U. S. Department. Other visitors include Dr. T. J. Headlee, State Entomologist of New Jersey, and Mr. H. B. Weiss of the State Department of Agriculture, New Jersey, and Prof. F. Rasmussen and Prof. J. G. Sanders of the Pennsylvania Department of Agriculture. A committee of the New Jersey State Board of Agriculture also recently spent part of a day at the Laboratory looking over the beetle situation.

Mr. R. Owen Wahl, Carnegie Student from South Africa, who spent the months from February to July in this country visiting field laboratories and experiment stations, in a letter to Doctor Howard written from Vancouver, B. C., July 21, on the eve of sailing for Australia, said: "Before leaving the continent, I would like to thank you, Doctor Quaintance, and all the host of entomologists I have met for their unfailing consideration and kindness to me. Always have I found the utmost hospitality and good fellowship and no one spared any trouble to make my stay pleasant as well as profitable If you have any means of conveying my sincere thanks to them I am sure you will do so. I am leaving the United States with great regret, but will always have the keenest interest in your wonderful country, and the thought of all the workers in entomology doing their bit will always be an inspiration to me."

Mr. G. A. Runner, in charge of the grape insect work for the Bureau of Entomology at the Federal laboratory at Sandusky, Ohio, reports severe injury from grape leafhoppers in vineyard sections of New York, Ohio, and Michigan, and that large numbers of grape growers have commenced spraying operations for control. In Ohio and Michigan the grape-berry moth has caused more than the usual amount of damage to the grape clusters by feeding on the stems or buds during the blossoming period. At Lawton, Mich., on June 8, Mr. Runner found cocoons of the grape-berry moth on the grape leaves. This shows an unusually early development of the larvae, as grapes were just out of bloom, and shows that early appearing larvae are able to complete fully their growth without entering the grape berries. At Paw Paw, Mich., bud clusters infested with the grape-blossom midge (*Contarinia johnsoni* Sling.) were observed on June 8. The insect had not been reported from that section previously.

The citrus black-fly, introduced into the Canal Zone from the West Indies, is rapidly spreading, according to Mr. James Zetek, who is in charge of the field station there. This pest is now well distributed for about twelve miles out from Panama City, all along the Canal Zone, and has been introduced in the interior at Aguadulce. Two entomogenous fungi, *Aschersonia aleyrodis* and *Aegerita webberi*, are following the black-fly, but are not sufficient to check it. Agriculture is still in its infancy in Panama so that practically no control or restrictive measures are being taken against

any pest. Mr. Zetek also reports the papaya fruit fly very abundant and well distributed wherever papayas are grown. In some of the papaya groves the damage due to this species amounts to 90 per cent. of the crop. In some parts of the interior of Panama it is impossible to grow papayas without having them infested, unless the very thick-fleshed varieties are grown. The picking and destroying of infested papayas, and allowing chickens to live in the grove, are the two most efficient control measures.

Mr. Harry Hargreaves, Government Entomologist of the British Protectorate of Uganda, Central Africa, spent several days in Washington recently visiting the Bureau of Entomology and acquainting himself with its work.

Mr. F. X. Williams, an entomologist of the Hawaiian Sugar Planters' Experiment Station, recently spent ten days in Washington on his way to northern South America where he will search for parasites of the sugar-cane wireworm in Hawaii.

Mr. G. S. Cotterell, a Carnegie scholar, has arrived in Washington and will spend about four months in the United States to familiarize himself with economic entomology in this country. He is Assistant Government Entomologist, Gold Coast Colony, West Africa.

Prof. Alphonso Herrera, Director de Estudios Biologicos de Mejico, visited the Bureau of Entomology at different times during the latter part of August. Professor Herrera has been investigating the research work of the Government, but has been especially interested in entomology.

Mr. Faustino Q. Otanes, of the Bureau of Agriculture, Philippine Islands, visited the Bureau of Entomology and will spend several months in the United States, familiarizing himself with the work being carried out by the Bureau at its various field stations.

In the United States Bureau of Entomology, Dr. C. L. Marlatt, assistant chief, has been advanced to Associate Chief of the Bureau in Charge of Regulatory Work, and Dr. A. L. Quanitance, in charge of Fruit Insect Investigations, has been advanced to Associate Chief in Charge of Research Work.

Preliminary tests of the efficiency of the aeroplane in distributing calcium arsenate dust upon cotton fields for control of the boll weevil were conducted during the latter part of the month at Scott, Miss., under the direction of B. R. Coad, of the Bureau of Entomology. Mr. Coad reports a remarkable evenness of distribution of the poison by this method.

Notes on Medical Entomology

Dr. T. J. Headlee visited Providence, R. I., September 11-13 to give expert advice in mosquito eradication in connection with the local campaign there.

Dr. W. V. King of the Bureau of Entomology attented a conference at Hamilton, Mont., on July 27, in order to obtain information regarding spotted fever conditions.

Prof. W. A. Riley of the University of Minnesota, is a member of an expedition from the Johns Hopkins University to Porto Rico to investigate the hook worm disease.

Dr. C. L. A. Laveran, professor at the Pasteur Institute, Paris, and the discoverer of the malarial parasite in Algeria in 1880, died May 18, at the age of 77. Dr. Laveran received the Nobel prize for medicine in 1907.

A meeting was held recently at Harvard University, at which the subject under discussion was the killing of flies and mosquitoes. Sanitary experts, business men and the heads of women's and children's welfare organizations of the metropolitan district were present. J. Albert C. Nyhea, director of fly and mosquito suppression of the Brookline Board of Health, and Prof. G. C. Whipple, of the engineering department of Harvard University, called the meeting, at which Prof. Whipple presided. Its purposes were to consider action to be taken in a co-operative movement for the suppression of mosquitoes and flies in the metropolitan area and to call a later meeting to start a state-wide campaign. It is hoped that all insect nuisances affecting public health may be abolished and the movement will try to include the flea and the biting fly.

Apicultural Notes

The 42d annual convention of the Ontario Beekeepers' Association will be held at Toronto, December 6-8.

Kentucky has enacted a new foul brood law with Professor Harrison Garman in charge of its administration.

The annual meeting of the Georgia Beekeepers' Association was scheduled to be held at Hopkins, Ga., August 24-26.

Mr. George R. Vansell has been appointed by the University of California for the work in beekeeping at the University Farm, Davis, Cal.

The annual field day of the Eastern Massachusetts Society of Beekeepers was scheduled to be held at Boston, Saturday, August 19, with Dr. E. F. Phillips as the principal speaker.

A joint field meeting of the Pennsylvania State Beekeepers' Association and the Northern Pennsylvania Beekeepers' Association was announced to be held August 3, at the apiary of Harry Beaver, Troy, Pa.

According to *Gleanings in Bee Culture*, the committee in charge of the Millet Memorial Fund has decided to locate the Memorial Library devoted to apiculture, at the University of Wisconsin, Madison, Wis.

The Wisconsin Beekeepers' Field Meeting and Conference was held at Green Bay, Wis., August 7-11. Speakers from outside the State were Dr. E. F. Phillips, E. R. Root, George S. Demuth and C. P. Dedant.

The Empire State Federation of Beekeepers' Co-operative Association, Inc., formerly the New York State Association of Beekeepers' Societies, announced the holding of an annual picnic and summer meeting at the home apiary of N. L. Stevens, Venice Center, Cayuga County, N. Y., on August 4.

The Maryland State Beekeepers' Association met for an afternoon field meeting at the Bee Culture Laboratory of the Bureau of Entomology on July 29. A short program was arranged by the members of the Bureau staff and the visitors were shown

about the Laboratory. This is the forth year that this Association has arranged such a visit to the Laboratory.

Dr. E. F. Phillips, apiculturist of the Bureau of Entomology, attended the annual field meeting of the Empire State Federation of Beekeepers' Co-operative Associations held at Venice Center, N. Y., on August 4; the extension short course in beekeeping given at the University of Wisconsin, August 7-11, and the annual meeting of the Eastern Massachusetts Beekeepers, Association, to be held near Boston, Mass., on August 19. He also expected to attend the annual field meeting of the Massachusetts Society of Beekeepers, at North Andover, Mass., September 2.

Horticultural Inspection Notes

On August 8 a large number of members of the New Jersey Nurserymen's Association, together with visitors from the Pennsylvania Nurserymen's Association, visited the Japanese Beetle Laboratory at Riverton, N. J., for the purpose of obtaining first-hand information about the beetle situation and observing the experimental work under way. Members of the Pennsylvania Horticultural Society on their annual automobile tour also visited the Laboratory earlier in the month.

Messrs. E. J. Newcomer and W. D. Whitcomb were in attendance at the fifth annual meeting of the Northwestern Association of Horticulturists, Entomologists, and Plant Pathologists which convened at Yakima, Wash., July 24–26. Several sessions were devoted to the reading of papers and to discussions. Field trips were made to commercial orchards, potato fields, coldstorage and packing plants, and to the experimental orchard and laboratory of the Bureau of Entomology.

Mr. Curtis A. Benton, who has been in charge of the Federal Port Inspection work at New Orleans during the past year, resigned the first of September for the purpose of taking post-graduate work at the University of Illinois.

Messrs. R. Kent Beattie, David Lumsden, and J. M. R. Adams, Foreign Plant Quarantine Service, Federal Horticultural Board, devoted considerable time during the months of August and September to visiting various establishments which have received plants during the past year under special permit.

Mr. E. R. Sasscer, of the Plant Quarantine Inspection Service, Federal Horticultural Board, recently visited the ports on the Mexican border as well as the maritime ports on the Pacific coast for the purpose of interviewing the inspectors and the customs officials located at these ports of entry.

The Annual Letter of Information, giving notes on pests collected from imported plants and plant products by State and Federal Inspectors from January 1, 1921 to December 31, 1921 inclusive, was recently published. This letter is available to all inspectors engaged in examination of foreign plant material.

The conference held by the Federal Horticultural Board in Washington to consider the potato wart situation on August 22d, was attended by the following State officials: Mel T. Cook, New Jersey, N. J. Giddings, West Virginia, T. B. Symons and R. A. Jehle, Maryland, W. A. McCubbin, Pennsylvania, and L. M. Massey, New York.

The following interesting interceptions were recently made by Mr. George Compere of the California State Department of Agriculture, stationed at San Francisco: Maggots of the Mexican fruit fly, *Anastrepha ludens* Loew., in mangos from Mexico; maggots of the melon fly, *Bactrocera cucurbitae* Coq., in cucumbers from Hawaii; and *Lepidosaphes auriculata* Green, on croton from Hawaii.

Mr. Lee A. Strong, Chief, Bureau Plant Quarantine, of the State of California, left Sacramento September first for the purpose of studying the port inspection methods employed in New York, Boston, Philadelphia and Washington. Incidentally while in the East Mr. Strong visited the Japanese Beetle laboratory at Riverton, New Jersey, and the Bean Beetle laboratory at Birmingham, Alabama.

Mr. Max Kisliuk, Jr., recently forwarded to Washington a moth which had been collected by a steward of a ship arriving in Philadelphia from Hull, England. The moth in question was collected while the vessel was in mid-ocean and has been identified by Dr. Schaus as the lappet moth, *Gastropacha quercifolia* Linn. Although this insect is not looked upon as a pest in England, its food plants include apple, plum, pear, hawthorn, blackthorn, willow and sallow.

Mr. Max Kisliuk, Jr., in cooperation with the post office officials in Philadelphia, intercepted on August 28th a sample package of cotton seed which had been shipped from Brazil. On close examination the seed was found to be infested with the pink boll worm. To further illustrate the danger of importing injurious insects in foreign mail shipments, Mr. Harris Sargent, who is in charge of the Federal Inspection Work at Portland, Oregon, reports that recently a consignee brought to his office a package containing approximately two pounds of cotton which had been delivered by the post-man to the latter. The cotton in question was shipped from Peru.

The fifteen-car fumigation house at Laredo, Texas, was totally destroyed by fire on July 19th. The fire originated at the oil tanks owned by the Humble Oil Company, which were located nearby and rapidly spread to the fumigation house. In addition to the destruction of the fumigation house, one carload of cyanid, one carload of sulphuric acid, three hydrocyanic-acid gas generators, and necessary acid, and cyanid mixing tanks were destroyed. At the time of the fire there were two empty railroad cars in the fumigation house which were also destroyed. The loss is estimated at approximately $35,000. Steps were immediately taken to draw up plans and secure bids covering the erection of a new fumigation house at that point.